STORMWATER MANAGEMENT PLAN
(SWMP)
for
LAKE SAN MARCOS ESTATES

H&A

HUNSAKER & ASSOCIATES

IRVINE • RIVERSIDE • SAN DIEGO
PLANNING • ENGINEERING • SURVEYING

HUNSAKER
& ASSOCIATES
SAN DIEGO, INC.

PLANNING
ENGINEERING
SURVEYING

IRVINE
RIVERSIDE
SAN DIEGO

STORMWATER MANAGEMENT PLAN (SWMP) for LAKE SAN MARCOS ESTATES

Proposed Residential Development
in the County of San Diego, California

Permit No. GPA 99-02/R98-003/TM 5131

W.O. 1375-57

July 3, 2002

Eric Mosolgo, PE
Water Resources Department Manager
Hunsaker & Associates San Diego, Inc.

REGISTERED PROFESSIONAL ENGINEER
ERIC MOSOLGO
NO. 62014
Exp. 09/30/05
CIVIL
STATE OF CALIFORNIA

DAVE HAMMAR
LEX WILLIMAN
ALISA VIALPANDO
DANA SEGUIN

RECEIVED
AUG 01 2002
DEPARTMENT OF PLANNING AND LAND USE

10179 Huennekens St.
San Diego, CA 92121
(858) 558-4500 PH
(858) 558-1414 FX
www.HunsakerSD.com
Info@HunsakerSD.com

EM:smm h:\reports\1375\057\a04.doc
w.o. 1375-57 7/3/02 9:34 AM

TABLE OF CONTENTS

INTRODUCTION

This Storm Water Management Plan (SWMP) has been prepared for the proposed Lake San Marcos Estates Project.

The owner/ designee is responsible to amend, document and date any erosion and sediment control activities on the attached plans as appropriate. This SWMP provides recommendations and procedures to fulfill storm water discharge requirements specified by various federal, state and county authorities. Site information, description, and responsible parties are provided within.

This SWMP has been prepared in accordance with the County of San Diego Ordinance No. 9424, which was adopted on February 20, 2002.

This SWMP will be implemented concurrently with commencement of soil-disturbing activities associated with new construction or immediately for ongoing construction projects. The requirements of the County of San Diego are intended to be implemented on a year-round basis.

If a change of ownership occurs, the new owner shall be informed of the provisions of the County of San Diego Ordinance and provided with a copy of this SWMP. The new owner shall amend this existing SWMP if necessary or develop a new SWMP.

This SWMP shall be amended whenever there is a change in construction or operations, which may affect the discharge of pollutants to surface waters, ground waters or a municipal separate storm sewer system (MS4). The SWMP shall also be amended if the discharger violates any condition of this County of San Diego Ordinance or has not achieved the general objective of reducing or eliminating pollutants in storm water discharges. All amendments should be dated and directly attached to the SWMP.

The County of San Diego may require the discharger to amend the SWMP.

1. DESCRIPTION OF PROPOSED PROJECT

1.1. Project Location

The proposed Lake San Marcos Estates Project (hereinafter referred to as Proposed Project) is located east of Rancho Santa Fe Road and just west of Lake San Marcos in the unincorporated community of Lake San Marcos in the county of San Diego.

1.2. Project Description

The project is a proposal for a residential development requiring a Tentative Map (5131), a General Plan Amendment (99-02) and a Rezone (98-003). A General Plan Amendment (GPA) is proposed to change the regional land use category for a portion of the site from Future Urban Development Area (FUDA) to Current Urban Development Area (CUDA), and the site-specific land use designation from Residential (1) to Residential (2). A rezone is also proposed for this project to modify the existing zoning from A70 (Limited Agriculture) and RR1 (Rural Residential) to RS1 (Single-family Residential).

The Proposed Project consists of a 105-unit residential development within a 126.1-acre parcel. The development includes 105 home sites, internal roadways, a swimming pool/spa facility and open space areas. The residences, roads and recreation facilities would comprise a total of 36.2 acres located in the northern portion of the property; the remaining 89.9 acres would consist of open space, most of which would be dedicated to the County in agricultural and biological open space easements.

1.2.1. Physical Features

The existing site is 126.1 acres, characterized by gentle to steeply sloping hillside terrain. A majority of the site consists of moderate-to steep-sided slopes, with approximately 67 percent of the site maintaining slopes between 15 and 50 percent grade. Elevations on site range between approximately 810 feet above mean sea level (MSL) on a knoll in the west-central portion of the site to 500 feet above MSL along portions of the eastern and southern site boundaries.

1.2.2. Land Use

A majority of the site is actively being farmed with avocado orchards. Improvements on site consist of structures and equipment used in the agricultural operations. Structures include two trailers, two small sheds, a carport and a small pump house. All of these facilities are located in the northwest corner of the site, in proximity to the existing dirt service/access road that originates from the terminus of Camino del Arroyo Drive. A few dirt roads cross the site, providing access for farming equipment.

1.3. Watershed Contribution

The Proposed Project is located in the San Marcos Creek watershed. A portion of the site drains to Lake San Marcos, while the remainder is tributary to the creek downstream of the lake. The 126.1 acres contributes 0.4% to the San Marcos Creek Watershed, while the proposed development contributes 0.1%. The 100-year peak flow from the site prior to construction is 215 cfs. After construction, the 100-year peak flow from the site is expected to be about 229 cfs, a 6.5% increase.

1.4. Maintenance Responsibility

The County Watershed Protection, Storm Water Management, and Discharge Control Ordinance obligates the project proponent to maintain all structural treatment BMPs that are part of their project. Improper or inadequate maintenance of this type of BMP could impact storm water and receiving water quality.

The Home Owners Association (HOA) will maintain the Proposed Project's maintenance activities and schedule.

2. APPLICABLE LAWS, REGULATIONS, POLICIES, AND REQUIREMENTS

2.1. FEDERAL LAWS AND REGULATIONS

This SWMP is in accordance with the State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS0108758 which was adopted on February 2001. The following excerpt will illustrate the permit requirements.

F.1.b Modify Development Project Approval Processes

Prior to project approval and issuance of local permits, Copermitees shall require each proposed project to implement measures to ensure that pollutants and runoff from the development will be reduced to the maximum extent practicable and will not cause or contribute to an exceedance of receiving water quality objectives. Each Copermitee shall further ensure that all development will be in compliance with Copermitee storm water ordinances, local permits, all other applicable ordinances and requirements, and this Order.

(1) Development Project Requirements

Each Copermitee shall include development project requirements in local permits to ensure that pollutant discharges and runoff flows from development are reduced to the maximum extent practicable and that receiving water quality objectives are not violated throughout the life of the project. Such requirements shall, at a minimum:

(a) Require project proponent to implement source control BMPs for all applicable development projects.

(b) Require project proponent to implement site design/landscape characteristics where feasible, which maximize infiltration, provide retention, slow runoff, and minimize impervious land coverage for all development projects.

(c) Require project proponent to implement buffer zones for natural water bodies, where feasible. Where buffer zone implementation is infeasible, require project proponent to implement other buffers such as trees, lighting restrictions, access restrictions, etc.

(d) Require industrial applicants subject to California's statewide General NPDES Permit for Storm Water Discharges Associated with Industrial Activities (Except Construction), (hereinafter General Industrial Permit), to provide evidence of coverage under the General Industrial Permit.

(e) Require project proponent to ensure its grading or other construction activities meet the provisions specified in Section F.2. of this Order.

Require project proponent to provide proof of a mechanism, which will ensure ongoing long-term maintenance of all structural post-construction BMPs.

2.1.1. Clean Water Act

Lake San Marcos Estates will ensure it is in compliance with the Clean Water Act (CWA). The CWA can be found on the Internet at http://www.epa.gov/owow/cwa/history.htm

2.1.1.1. Section 401 –Water Quality Certification

Lake San Marcos Estates will ensure it is in compliance with the 401 permit, which can be found on the Internet at: http://www.swrcb.ca.gov/rwqcb7/regulatory2/faqs_401.htm

2.2. STATE LAWS AND REGULATIONS

2.2.1. California Water Code – Porter Cologne Water Quality Control

Lake San Marcos Estates will ensure it is in compliance with the Porter Cologne Water Quality Control Act of 1969, which can be found on the Internet at: http://ceres.ca.gov/wetlands/permitting/tbl_cntnts_porter.html

2.2.2. Regional Permit

A NOI will be filed and a SWPPP prepared at the appropriate time. The SWPPP will comply with the National Pollution Discharge Elimination System (NPDES) Stormwater Program.

2.2.3. State Impaired Water bodies "303(d) list"

The development of this site will not measurably impact any of the 303d Water bodies as published by the State of California, 1998. Runoff from the project area eventually drains to Batiquitos Lagoon, which is located roughly (5) miles west of the project site.

3. POTENTIAL EFFECTS TO THE WATER QUALITY ENVIRONMENT

3.1. Beneficial Uses

The hydrological unit for the portion of the project draining to Lake San Marcos is 4.52 (Richland HSA). The hydrological unit for the portion of the project draining to San Marcos Creek, downstream of the lake, is 4.51 (Batiquitos HSA). The beneficial uses for these hydrologic subunits are found in the California Regional Water Quality Control Board San Diego Region Basin Plan, dated May 5, 1998.

3.2. Surface Waters

3.2.1. Surface Water Quality Objectives and Beneficial Uses

The existing beneficial uses of inland surface waters for San Marcos Creek are: Agricultural Supply (AGR), Contact Water Recreation (REC-1), Non-contact Water Recreation (REC-2), Warm Freshwater Habitat (WARM), and Wildlife Habitat (WILD).

3.3. Groundwater

No infiltration facilities will be used on site; therefore groundwater will not be an issue.

4. CHARACTERIZATION OF PROJECT RUNOFF

4.1. Storm Water Quality at Outfall

The table on the following page illustrates the potential pollutants found in the storm water from the site.

Anticipated and Potential Pollutants from the Project Area

	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >100,000 ft^2	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft^2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		
Retail Gas Outlets			X	X(4)	X		X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

Sediments are soils or other surface materials eroded and then transported or deposited by the action of wind, water, ice, or gravity.

Nutrients are inorganic substances, such as nitrogen and phosphorous. They commonly exist in the form of mineral salts that are either dissolved or suspended in water. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.

Trash & Debris, such as paper, plastic, leaves, grass cuttings, and food waste, may have a significant impact on the recreational value of a water body and aquatic habitat.

Oxygen-Demanding Substances include biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds.

Oil and Grease are characterized as high high-molecular weight organic compounds. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, oils, waxes, and high-molecular weight fatty acids.

Bacteria and Viruses are micro-organisms whose proliferation is typically caused by the transport of animal or human fecal wastes from the watershed.

Pesticides are chemicals used to kill pests such as insects and rodents.

4.2. Tributary Drainage Area to Outfall

Runoff from the site discharges to one of three outfalls: 1) western property boundary (12 acres currently and 14 acres proposed), 2) southern property boundary (64 acres currently and 65 acres proposed), and 3) eastern property boundary (51 acres currently and 48 acres proposed). The drainage areas or patterns will not be significantly altered by this project.

4.3. Site Hydrology

A hydrology report by Hunsaker & Associates, dated September 19, 2000, details the drainage sub basins on site. Hydrology calculations and maps for both the existing and developed conditions are contained within the hydrology report. The 2 and 10-year pre and post development peak flows and runoff volumes are as follows:

WATERSHED 1			
EXISTING	Q10 =	15.6 cfs	V10 =	0.92 ac-ft
	Q2 =	10.8 cfs	V2 =	0.64 ac-ft
PROPOSED	Q10 =	20.2 cfs	V10 =	1.31 ac-ft
	Q2 =	14.0 cfs	V2 =	0.90 ac-ft
WATERSHED 2				
EXISTING	Q10 =	70.9 cfs	V10 =	5.06 ac-ft
	Q2 =	49.0 cfs	V2 =	3.50 ac-ft
PROPOSED	Q10 =	70.3 cfs	V10 =	5.23 ac-ft
	Q2 =	48.5 cfs	V2 =	3.61 ac-ft
WATERSHED 3				
EXISTING	Q10 =	52.0 cfs	V10 =	4.01 ac-ft
	Q2 =	35.9 cfs	V2 =	2.77 ac-ft
PROPOSED	Q10 =	52.9 cfs	V10 =	3.94 ac-ft
	Q2 =	36.5 cfs	V2 =	2.72 ac-ft
TOTAL				
EXISTING	Q10 =	139 cfs	V10 =	10.0 ac-ft
	Q2 =	96 cfs	V2 =	6.9 ac-ft
PROPOSED	Q10 =	143 cfs	V10 =	10.5 ac-ft
	Q2 =	99 cfs	V2 =	7.2 ac-ft

4.4. Water Quality Treatment Volume Based on Water Quality Design Storm

The water quality treatment volumes are 0.17 acre-feet, 0.10 acre-feet, and 0.16 acre-feet for Watersheds 1, 2, and 3, respectively, based on the water quality design storm. Three Vortechs Model 1000 units will be used to treat the entire volume of this storm, the peak flow of which is 0.9 cfs for Watershed 1, 0.5 cfs for Watershed 2, and 0.8 cfs for Watershed 3.

The following table illustrates the expected outfall quality of storm water, following treatment.

Source & Treatment Control BMP Removal Efficiencies

Pollutant of Concern	BMP Categories		
	Landscaping/ Biofilters	Hydrodynamic Separation Devices(3)	Vortechs™ Stormwater Treatment System
Sediment	M	M-H	H
Nutrients	L	L-M	L-M
Heavy Metals	M	L-M	L-M
Organic Compounds	U	L-M	L-M
Trash & Debris	L	M-H	H
Oxygen Demanding Substances	L	L	L
Bacteria	U	L	L
Oil & Grease	M	L-H	H
Pesticides	U	L	L

(1) The County will periodically assess the performance characteristics of many of these BMPs to update this table.
(3) Proprietary Structural BMPs. Not all serve the same function.
L (Low): Low removal efficiency
M (Medium): Medium removal efficiency
H (High): High removal efficiency
U: Unknown removal efficiency, applicant must provide evidence supporting use

Sources: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1993), *National Stormwater Best Management Practices Database* (2001), and *Guide for BMP Selection in Urban Developed Areas* (2001).

4.5. Soil Characteristics

Mapped topsoils within the project site include: 1) (primarily) well-drained, rocky silt loams on steep slopes, with shallow profiles (typically between 8 and 17 inches) and rapid runoff and high erosion potential; 2) excessively-drained, rocky course-sandy loams, on moderate to steep slopes, with shallow profiles (5 to 15 inches), moderate to rapid runoff potential, and moderate to high erosion potential, depending on the slope; and 3) well-drained, very fine sandy loams, with moderately deep profiles (20 to 34 inches), medium to rapid runoff and moderate to high erosion potential, depending on slope.

The majority of the site is underlain by granitic and fractured metavolcanic rocks.

5. MITIGATION MEASURES TO PROTECT WATER QUALITY

5.1. Pollution Prevention BMPs

Pollution prevention BMPs will include at least the following measures:

1.) Stabilization of pervious surfaces through non-native landscaping;

2.) Installation of water efficient irrigation devices on "common" areas throughout the development;

3.) A new owner information package comprised of information pamphlets relating to stormwater and pollution prevention;

4.) All onsite storm drain inlets will be stenciled with "Don't Dump – Drains to ___".

5.) Source controls, which are implemented to prevent or reduce the presence of pollutants and minimize the contact between pollutants and urban runoff, include the following:

- ***Landscaping*** - Manufactured slopes shall be landscaped with suitable ground cover or installed with an erosion control system. Homeowners should be educated as to the proper routine maintenance to landscaped areas including trimming, pruning, weeding, mowing, replacement or substitution of vegetation in ornamental and required landscapes.

  Per the RWQCB Order, the following landscaping activities are deemed unlawful and are thus prohibited:

  - Discharges of sediment, pet waste, vegetative clippings, or other landscaping or construction-related wastes.

- ***Urban Housekeeping*** - Fertilizer applied by homeowners, in addition to organic matter such as leaves and lawn clippings, all result in nutrients in storm water runoff. Consumer use of excessive herbicide or pesticide contributes toxic chemicals to runoff. Homeowners should be educated as to the proper application of fertilizers and herbicides to lawns and gardens.

  The average household contains a wide variety of toxins such as oil/grease, antifreeze, paint, household cleaners and solvents. Homeowners should be educated as to the proper use, storage, and disposal of these potential storm water runoff contaminants.

  Per the RWQCB Order, the following housekeeping activities are deemed unlawful and are thus prohibited:

- Discharges of wash water from the cleaning or hosing of impervious surfaces including parking lots, streets, sidewalks, driveways, patios, plazas, and outdoor eating and drinking areas. Landscape irrigation and lawn watering, as well as non-commercial washing of vehicles in residential zones, is exempt from this restriction.

- Discharges of pool or fountain water containing chloride, biocides, or other chemicals.

- Discharges or runoff from material storage areas containing chemicals, fuels, grease, oil, or other hazardous materials.

- Discharges of food-related wastes (grease, food processing, trash bin wash water, etc.).

- ***Automobile Use*** – Urban pollutants resulting from automobile use include oil, grease, antifreeze, hydraulic fluids, copper from brakes, and various fuels. Homeowners should be educated as to the proper use, storage, and disposal of these potential storm water contaminants.

Per the RWQCB Order, the following automobile use activities are deemed unlawful and are thus prohibited:

- Discharges of wash water from the hosing or cleaning of gas stations, auto repair garages, or other types of automotive service facilities.

- Discharges resulting from the cleaning, repair, or maintenance of any type of equipment, machinery, or facility including motor vehicles, cement-related equipment, port-a-potty servicing, etc.

- Discharges of wash water from mobile operations such as mobile automobile washing, steam cleaning, power washing, and carpet cleaning

The Homeowners Association should make all homeowners aware of the aforementioned RWQCB regulations through a homeowners' education program. A monitoring program should also be implemented to insure compliance.

6). In developed conditions, 71% of the 126.1 acre site will remain undisturbed.

5.2. <u>Post Construction</u> Treatment BMPs

Treatment BMPs include Vortechs units for each storm drain system and energy dissipation at each outfall.

The Vortechs Stormwater Treatment System is one of several types of separation devices that depend on gravity and/or swirl concentrator technology to effectively capture sediment, gross pollutants, oil & grease, and other pollutants that attach themselves to these pollutants or settle out. These devices have been shown in field tests to remove pollutants of concern to various degrees. Factors that influence the pollutant removal efficiencies include design, maintenance, flow rate, and the application conditions, but generally these devices are rated with a medium to high removal efficiency for sediment and gross pollutants. Field and laboratory testing of the Vortechs System has generally shown better pollutant removal efficiencies than other similar units.

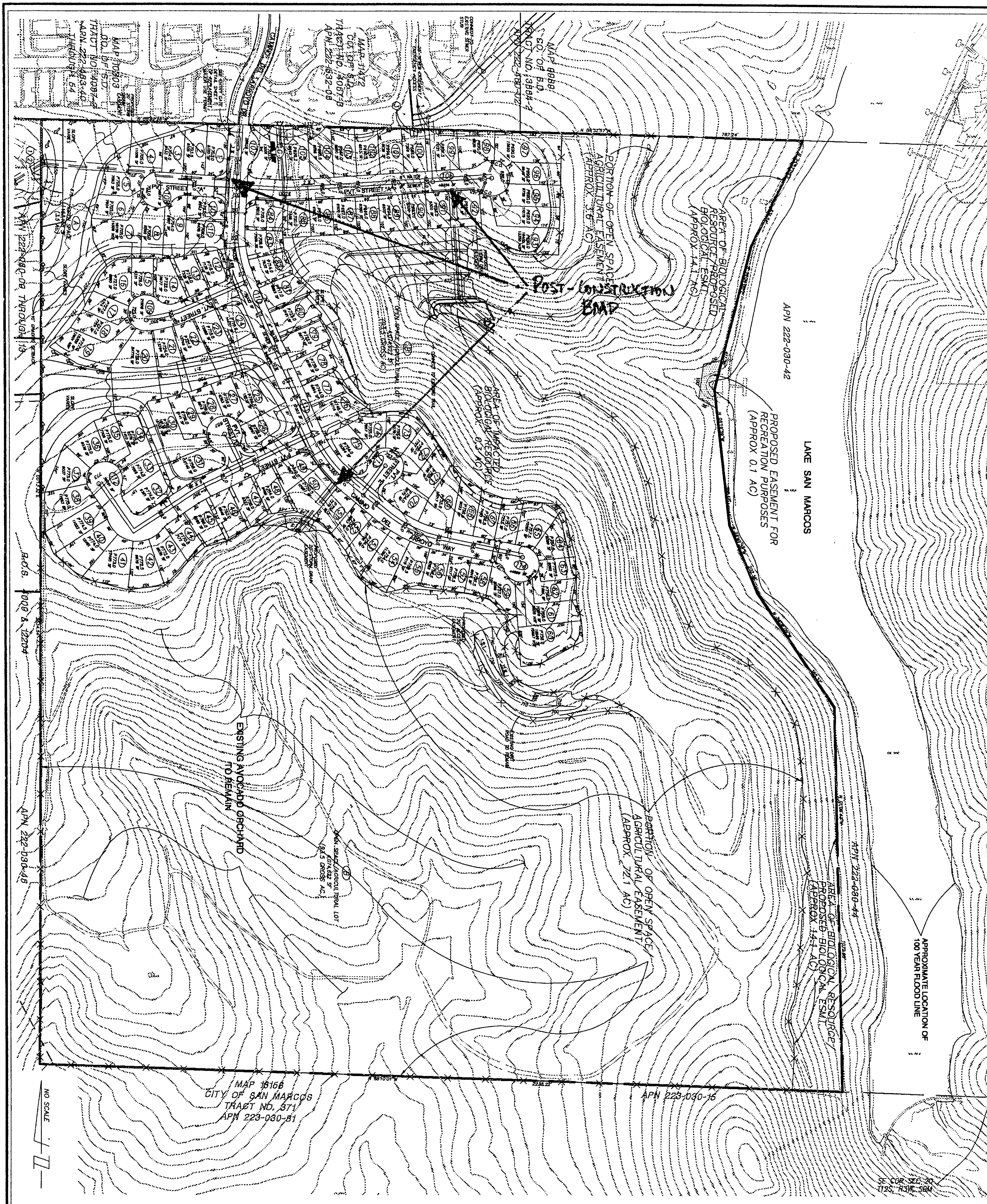
Energy dissipation devices, stabilized outfalls, high-flow bypasses, stream bank stabilization, and other structural controls necessary to prevent channel erosion will be used. These will be constructed at each storm drain outlet. Energy dissipation will include riprap pads and vegetation downstream, which, when properly designed and installed, are effective at reducing velocities and the subsequent potential for local scour and erosion from increased runoff.

5.3. <u>Construction Treatment BMPs</u>

<u>Before beginning any construction activities that would modify the drainage pattern on the property, all applicable federal, state, and local permits would be obtained. Such permits include the National Pollution Discharge Elimination System (NPDES) permit from the Regional Water Quality Control Board (RWQCB). The General Permit for Construction Activity, developed by the Storm Water Discharges Association, was enacted by the RWQCB and requires owners of land where construction activity occurs to:</u>

- <u>Develop and implement a Storm Water Pollution Prevention Plan (SWPPP) that specifies Best Management Practices (BMPs) that will prevent construction pollutants from contacting storm water. The intent of this plan is also to prevent products of erosion from draining offsite to receiving areas.</u>

- <u>Eliminate or reduce non-storm water discharges to storm water systems and other waters of the nation.</u>



PREPARED BY:

HUNSAKER & ASSOCIATES SAN DIEGO, INC.

TENTATIVE MAP/MAJOR USE PERMIT/REZONE/ GENERAL PLAN AMENDMENT

LAKE SAN MARCOS ESTATES

COUNTY OF SAN DIEGO TM NO. 5131, GPA NO. 99-02, MUP NO. P 98-012 AND REZONE NO. R 98-003

PROPOSED PROJECT

FIGURE A

- Perform inspections of all BMPs.

  Construction activities include clearing, grading, or excavation that results in the disturbance of at least five acres of total land area. Disturbance can result from removing vegetative cover and exposing soils or by placing mined or dredged material on top of the existing ground.

  Construction waste is typically not biologically significant. However, any excess lumber or other waste, especially smaller pieces that could be carried offsite by storm water, could have a negative impact downstream. Packaging material such as paper, cellophane and plastics can be harmful to the environment in a similar manner.

  Soil erosion can be a major source of pollutants from construction activities due to the area of ground exposed to erosion by water and wind. The onsite soil can be prone to absorb and bind toxic pollutants and is susceptible to erosion. Concrete washout, while not toxic, does contain some fine particulates that are detrimental to some beneficial uses of waterways.

  To mitigate pollution from construction activities to the receiving streams, the following Best Management Practices should be implemented.

- Practice Good Housekeeping – perform activities in a manner that keeps potential pollutants from leaving the site by managing pollutant sources and modifying construction activities.

- Contain Waste – dispose of all construction waste in designated areas and keep storm water from entering or leaving these areas.

- Stabilize Disturbed Areas – provide temporary stabilization of disturbed soils whenever construction is not occurring on that portion of the site. Provide permanent stabilization after fine grading operations and landscape the site.

- Control Site Perimeter – runoff from the project site should be free from excessive sediment and other pollutants.

- Control Internal Erosion – detain waters that contain sediment and other pollutants from the disturbed areas of the site.

The contractor can reduce the amount of sediment and other pollutants by managing construction activities. This involves structure construction and painting, material delivery and storage, solid waste management, hazardous waste management, concrete waste management, plus vehicle and equipment management.

An erosion control plan includes seeding and planting guidelines, dust control, stabilized construction entrance, silt fences, straw bale barriers, sand bag barriers, storm drain inlet protection, and sediment basins.

6. MAINTENANCE STORMWATER MANAGEMENT PROGRAM

6.1. Maintenance Responsibility

The responsibility to maintain BMPs for the Proposed Project will be that of the HOA and/or County. Improper or inadequate maintenance of BMPs could impact storm water and receiving water quality.

6.2. Maintenance of Vortechs System Units

Regularly scheduled maintenance of the Vortechs units will consist of not less than quarterly inspections during construction and not less than annual inspections thereafter. In addition, during construction, inspections shall be done following each runoff-producing storm event. The HOA will contract with a company qualified to inspect and maintain the units. The Vortechs units shall be cleaned as needed (as determined by the results of the inspections), in accordance with Vortechnics guidelines and/or specifications for maintaining effectiveness. Inspection and maintenance records shall be retained for at least three years.

6.2.1. Design Criteria, Routine Action

Numeric sizing criteria was established by the RWQCB for sizing post-construction BMPs. For flow-based BMPs, such as the Vortechs system units, the peak runoff generated from 0.2 inches of rainfall in an hour must be treated. Other design criteria have not yet been established, but the hydrologic calculations in Appendix C illustrate how the Model 1000 will effectively treat the peak runoff from the 0.2 inches of rainfall in an hour. In fact, because the units will be offline, they will even operate during a 50-year storm event without losing the pollutants that they capture.

6.2.2. Maintenance Indicators

The indication that maintenance is necessary is when the sediment pile is within 6 inches of the water surface elevation in the grit chamber. Another indication that maintenance is necessary is if there is enough trash in the unit to impede the flow. This may vary depending on what type of trash or debris has accumulated. Finally, if there is more than just a sheen of oil in the system it may need to be cleaned out. This could be an indication of an oil spill or an illegal oil dumping in the upstream storm drain. These things can only be determined with routine inspections.

6.2.3. Field Measurement

The best way to tell if the system has too much trash and debris or oil is by a simple visual inspection through the access port centered above the grit chamber. To determine the amount of sediment accumulation if a visual inspection is not possible, a simple stadia rod or stick works well. With this "tool" you can determine where the sediment pile is in relation to the water surface elevation. The sediment accumulations should be highest at the center, which is where the measurement should be made.

6.2.4. Measurement Frequency

Quarterly inspections are recommended for the first year after the site comes to equilibrium. During construction, if there is a potential for heavy sediment accumulation, a more frequent inspection frequency will be used.

6.2.5. Maintenance Activity

Maintenance activity typically depends on site conditions. On average, the Vortechs System is cleaned out on an annual basis. Many sites can go longer than this if pollutant loadings are lower, and some must be maintained more frequently. During construction especially, the system may need to be maintained on more of a regular basis if there is high sediment loading.

6.2.6. Site-Specific Requirements

There are no site-specific requirements or issues of concern.

6.2.7. Annual Maintenance Costs

Per information obtained from Vortechnics regarding the long-term maintenance of the proposed storm water treatment units, each unit requires maintenance roughly (1) time per year. The maintenance involves the use of a "vactor truck", which clears the grit chamber of the Vortechnics unit by vacuuming all the grit and water from the sump. A 3-man crew is typically required to perform the maintenance of the Vortechnics units. Here are the yearly maintenance cost estimates for the various treatment units recommended by Vortechnics.

Model 1000...Estimated Yearly Maintenance Cost = $500/unit

Model 2000...Estimated Yearly Maintenance Cost = $750/Unit

Model 3000....Estimated Yearly Maintenance Cost = $1,000/unit

Model 4000...Estimated Yearly Maintenance Cost = $1,250/unit

Model 5000...Estimated Yearly Maintenance Cost = $1,500/unit

Three (3) Model 1000s would be required to treat first flush runoff from the project site. Thus, the projected yearly maintenance cost for the site would be $1,500.

6.3. Maintenance of Energy Dissipation Devices

Regularly scheduled maintenance of energy dissipation devices will consist of not less than annual inspections of the devices and downstream conditions.

6.3.1. Design Criteria, Routine Action

Energy dissipator structures are typically designed for peak flows and velocities associated with a 50- or 100-year design storm event, in accordance with the Regional Standard Drawings. Internal energy dissipator rings and riprap basins are also used effectively when designed properly.

6.3.2. Maintenance Indicators

An indication that maintenance is necessary is when any part of the structure or device is unraveling or when vegetation (such as willows) have established themselves too close to the outfall, so as to potentially cause blockage of the outfall.

6.3.3. Field Measurement

A simple visual inspection will adequately determine the need for maintenance.

6.3.4. Measurement Frequency

Inspections will be conducted at least quarterly during the first year and annually thereafter.

6.3.5. Maintenance Activity

Maintenance activity is typically confined to clearing of vegetation that could undermine the structure or obstruct flow.

6.3.6. Site-Specific Requirements

There are no site-specific issues of concern.

6.4. Maintenance of Landscaping and Irrigation

Regularly scheduled maintenance of the landscaping and irrigation system will consist of careful observations of all the hydrozones and irrigation system to determine any needed adjustments in the irrigation schedule.

6.4.1. Design Criteria, Routine Action

No design criteria is associated with this BMP.

6.4.2. Maintenance Indicators

An indication that maintenance is necessary is when the landscaping is too dry or wet, or when there is irrigation runoff from the site. Another indication is when any non-living ground cover, such as bark mulch, is not adequately covering the ground it is meant to cover. These things will be determined with routine inspections.

6.4.3. Field Measurement

A simple visual inspection will adequately determine the need for maintenance.

6.4.4. Measurement Frequency

Inspections will be conducted as frequently as landscape maintenance activities. This is expected to be often, possibly weekly.

6.4.5. Maintenance Activity

Maintenance activity typically depends on site and climatic conditions. Repairs and adjustments to the irrigation schedule or individual drip emitters will need to be determined as conditions warrant. Replacement or supplementing of bark mulch will also need to be determined as conditions warrant.

6.4.6. Site-Specific Requirements

There are no site-specific issues of concern.

7. DISPOSAL OF STORMWATER SEDIMENT

Annual (or more frequent) cleaning of the Vortechs unit will allow the material to be disposed of in a sanitary landfill.

7.1 Monitoring

Over time, more data and information will become available, and it may be necessary to revise the inspection and/or cleaning schedules to better reflect the knowledge gained.

8. FISCAL RESOURCES

8.1. Agreements

The Home Owners Association will be responsible to maintain the funding of the maintenance activities. The Maintenance agreement(s) will be found with the Home Owners Association's secretary.

9. PROGRAM EVALUATION

The plan provides for servicing of all post-construction structural BMPs at least annually, and for the retention of inspection and maintenance records for at least three (3) years.

If more frequent inspection and/or servicing is deemed necessary by the inspector and the HOA, jointly, the maintenance schedule will be revised accordingly.

10. REFERENCES

1. Clean Water Act http://www.epa.gov/owow/cwa/history.htm

2. 401 Certification
http://www.swrcb.ca.gov/rwqcb7/regulatory2/faqs_401.htm

3. Porter Cologne Water Quality Control Act of 1969
http://ceres.ca.gov/wetlands/permitting/tbl_cntnts_porter.html

4. National Pollutant Discharge Elimination System (NPDES)

5. Storm Water Permit #CAS000002 and State Water Resources Control Board Order 99-08

6. Grading Ordinance – Sections 87.101 through 87.717 of San Diego County Code of Regulatory Ordinances on the Web at http://www.amlegal.com/alpeg004.htm

7. Stormwater Ordinance – Sections 67.801 through 67.811 of San Diego County Code of Regulatory Ordinances on the WEB at http://www.amlegal.com/alpeg004.htm

8. CALTRANS Storm Water BMP Handbook for Construction dated March 1993

9. DLI-LD-H, Procedures for Stormwater Regulations Compliance

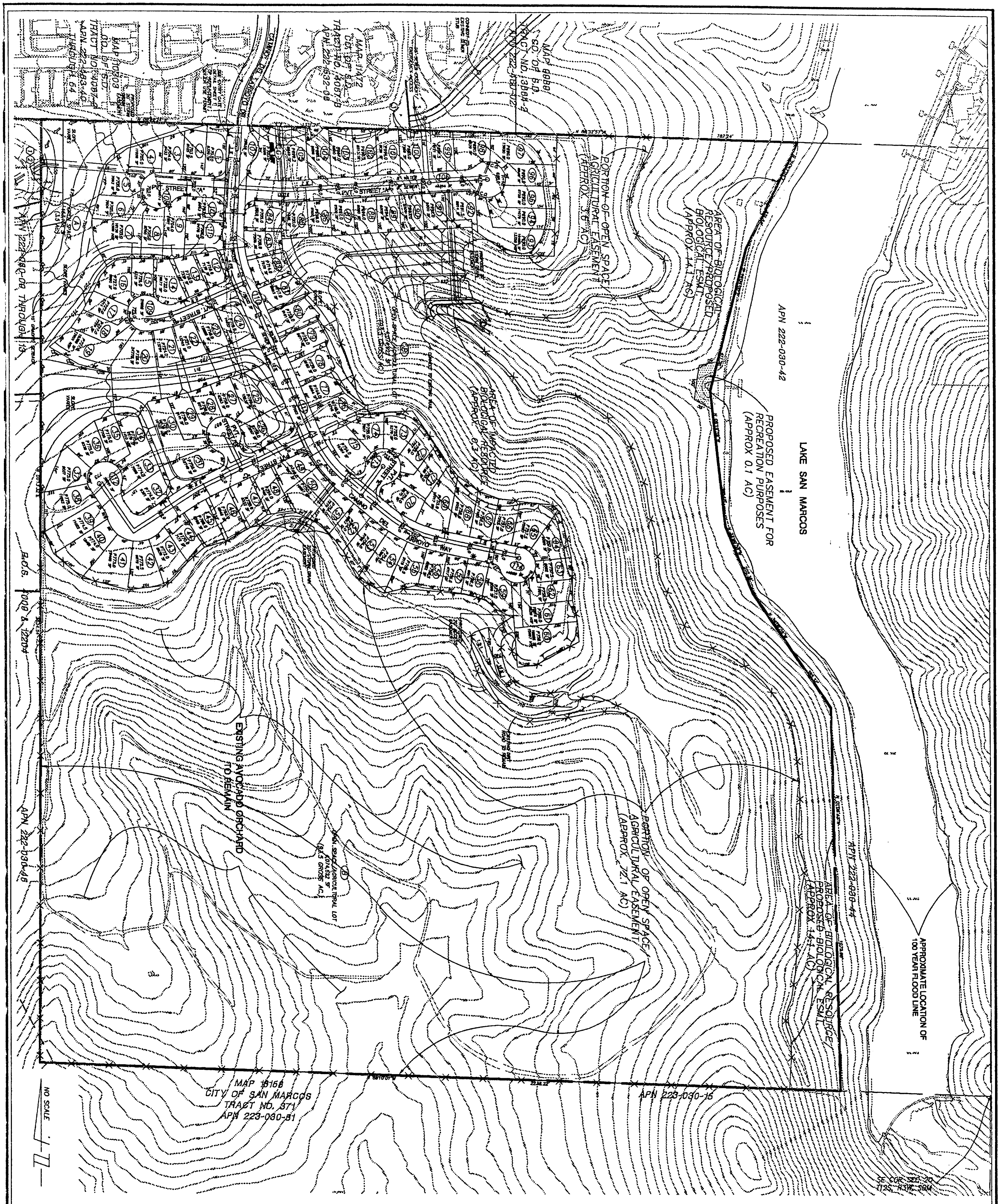
LIST OF FIGURES

A. Project Map

The Project Map for the Proposed Project is attached as Figure A.

B. Watersheds and Surface Water Bodies Within Project Area

Figure B shows the Proposed Project relative to San Marcos Lake and the watershed upstream of the lake.



PREPARED BY:

HUNSAKER & ASSOCIATES SAN DIEGO, INC

TENTATIVE MAP/MAJOR USE PERMIT/REZONE/ GENERAL PLAN AMENDMENT

LAKE SAN MARCOS ESTATES

COUNTY OF SAN DIEGO TM NO. 5131, GPA NO. 99-02, MUP NO. P 98-012 AND REZONE NO. R 98-003

PROPOSED PROJECT

FIGURE A

HUNSAKER & ASSOCIATES
SAN DIEGO, INC

PLANNING 10179 Huennekens Street
ENGINEERING San Diego, Ca 92121
SURVEYING PH(858)558-4500 · FX(858)558-1414

WATERSHEDS AND SURFACE WATERS
WITHIN PROJECT AREA FOR
LAKE SAN MARCOS ESTATES

FIG.
B

R:\0269\Exhibits\HYD\Ex Batiquitos Watershed.dwg[2018]Apr-23-2002:14:49

APPENDIX A

Calculations

LAKE SAN MARCOS ESTATES

Rational Method Results for Existing Area EX1

1) Time of Concentration, Tc = 13.2 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, Average C

C =	0.45	0.55	0.55
	Development Area (ac)		
	11.70	0.00	0.00

sum of areas	11.7	0.0	0.0	0.0	=	**11.70 ac.**
			weighted average C =			0.45

3) Then for Tc = 13.2 minutes

I_{100} =	4.52 in/hr	for P6	3.20	in.	then Q_{100} =	23.8 cfs	V_{100} =	1.40 ac-ft
I_{50} =	3.53 in/hr	for P6	2.50	in.	then Q_{50} =	18.6 cfs	V_{50} =	1.10 ac-ft
I_{10} =	2.96 in/hr	for P6	2.10	in.	then Q_{10} =	15.6 cfs	V_{10} =	0.92 ac-ft
I_2 =	2.05 in/hr	for P6	1.45	in.	then Q_2 =	10.8 cfs	V_2 =	0.64 ac-ft

LAKE SAN MARCOS ESTATES

Rational Method results at Developed Watershed 1

1) Time of Concentration, Tc = 15.2 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, % Impervious

C =	0.55	0.55	0.51	0.55		
Development Area (ac)						
	0.2	3.2	11.00			
sum of areas	0.2	3.2	11.0	0.0	=	**14.4 ac.**
% impervious	35	35	25	35		**27.4% impervious**
				weighted average C =		0.52

3) Then for Tc = 15.2 minutes

I_{100} =	4.12 in/hr	for P6	3.20 in.	then Q_{100} =	30.8	cfs	V_{100} =	1.99	ac-ft
I_{50} =	3.22 in/hr	for P6	2.50 in.	then Q_{50} =	24.1	cfs	V_{50} =	1.56	ac-ft
I_{10} =	2.70 in/hr	for P6	2.10 in.	then Q_{10} =	20.2	cfs	V_{10} =	1.31	ac-ft
I_2 =	1.87 in/hr	for P6	1.45 in.	then Q_2 =	14.0	cfs	V_2 =	0.90	ac-ft

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 1

RUNOFF HYDROGRAPH (SBUH METHOD - 6-Hour Storm Event)

Given:	Area	=	14.4	acres				
	Pt	=	0.72	inches (Total rainfall for an 85th percentile - 24 hour storm event)				
	dt	=	10.0	min.				
	Tc	=	15.2	min. (Developed site conditions)				
	% IMP =		27%					
	PERVIOUS Parcel				IMPERVIOUS Parcel			
	Area	=	10.5	acres	Area	=	3.9	acres
	CN	=	68		CN	=	98	(assuming dry antecedent moisture condition)
	S	=	4.71		S	=	0.20	
	0.2S	=	0.94		0.2S	=	0.04	

Compute Developed Conditions Runoff hydrograph

Column (3) = Rainfall Distribution for San Diego County
Column (4) = Col. (3) x Pt = 85th percentile - 6 Hour Hyetograph at this location.
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; use PERVIOUS Area "S" value. [If P > 0.2S] = $(\text{Col.}(5) - 0.2S)^2/(\text{Col.}(5) + 0.8S)$; use PERVIOUS Area "S" value.
Column (7) = Col.(6) of present time step - Col.(6) of previous time step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes);Routing Constant, w = dt / (2Tc + dt) = 0.2479
Column (12) = Col.(12) of previous time step + (w x [Col.(11) of previous time step + Col.(11) of present time step - (2 x Col.(12) of previous time step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs	
1	10	0.0166	0.0120	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
2	20	0.0166	0.0120	0.0239	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
3	30	0.0166	0.0120	0.0359	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
4	40	0.0200	0.0144	0.0503	0.0000	0.0000	0.0004	0.0004	0.0001	0.01	0.00	
5	50	0.0200	0.0144	0.0647	0.0000	0.0000	0.0025	0.0021	0.0006	0.05	0.02	
6	60	0.0200	0.0144	0.0791	0.0000	0.0000	0.0060	0.0035	0.0010	0.08	0.04	
7	70	0.0226	0.0163	0.0953	0.0000	0.0000	0.0115	0.0055	0.0015	0.13	0.07	
8	80	0.0226	0.0163	0.1116	0.0000	0.0000	0.0182	0.0067	0.0018	0.16	0.11	
9	90	0.0226	0.0163	0.1279	0.0000	0.0000	0.0260	0.0078	0.0021	0.19	0.14	
10	100	0.0334	0.0240	0.1519	0.0000	0.0000	0.0392	0.0131	0.0036	0.31	0.19	
11	110	0.0334	0.0240	0.1760	0.0000	0.0000	0.0538	0.0147	0.0040	0.35	0.26	
12	120	0.0334	0.0240	0.2000	0.0000	0.0000	0.0698	0.0159	0.0044	0.38	0.31	
13	130	0.0778	0.0560	0.2560	0.0000	0.0000	0.1105	0.0407	0.0111	0.97	0.49	
14	140	0.0778	0.0560	0.3120	0.0000	0.0000	0.1548	0.0443	0.0121	1.06	0.75	
15	150	0.0778	0.0560	0.3680	0.0000	0.0000	0.2015	0.0468	0.0128	1.11	0.92	**<<<peak**
16	160	0.0334	0.0240	0.3921	0.0000	0.0000	0.2222	0.0207	0.0057	0.49	0.86	
17	170	0.0334	0.0240	0.4161	0.0000	0.0000	0.2431	0.0209	0.0057	0.50	0.68	

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 1

(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
18	180	0.0334	0.0240	0.4402	0.0000	0.0000	0.2643	0.0212	0.0058	0.50	0.59
19	190	0.0316	0.0228	0.4629	0.0000	0.0000	0.2845	0.0202	0.0055	0.48	0.54
20	200	0.0316	0.0228	0.4857	0.0000	0.0000	0.3050	0.0204	0.0056	0.49	0.51
21	210	0.0316	0.0228	0.5084	0.0000	0.0000	0.3255	0.0206	0.0056	0.49	0.50
22	220	0.0234	0.0168	0.5253	0.0000	0.0000	0.3409	0.0153	0.0042	0.37	0.47
23	230	0.0234	0.0168	0.5421	0.0000	0.0000	0.3563	0.0154	0.0042	0.37	0.42
24	240	0.0233	0.0168	0.5589	0.0000	0.0000	0.3717	0.0154	0.0042	0.37	0.39
25	250	0.0213	0.0153	0.5742	0.0000	0.0000	0.3858	0.0141	0.0039	0.34	0.37
26	260	0.0213	0.0153	0.5896	0.0000	0.0000	0.4000	0.0142	0.0039	0.34	0.35
27	270	0.0213	0.0153	0.6049	0.0000	0.0000	0.4142	0.0142	0.0039	0.34	0.35
28	280	0.0175	0.0126	0.6175	0.0000	0.0000	0.4259	0.0117	0.0032	0.28	0.33
29	290	0.0175	0.0126	0.6301	0.0000	0.0000	0.4377	0.0118	0.0032	0.28	0.30
30	300	0.0175	0.0126	0.6427	0.0000	0.0000	0.4495	0.0118	0.0032	0.28	0.29
31	310	0.0183	0.0132	0.6559	0.0000	0.0000	0.4618	0.0123	0.0034	0.29	0.29
32	320	0.0183	0.0132	0.6691	0.0000	0.0000	0.4742	0.0124	0.0034	0.29	0.29
33	330	0.0183	0.0132	0.6822	0.0000	0.0000	0.4866	0.0124	0.0034	0.30	0.29
34	340	0.0175	0.0126	0.6948	0.0000	0.0000	0.4985	0.0119	0.0032	0.28	0.29
35	350	0.0175	0.0126	0.7074	0.0000	0.0000	0.5104	0.0119	0.0033	0.28	0.29
36	360	0.0175	0.0126	0.7200	0.0000	0.0000	0.5223	0.0119	0.0033	0.28	0.29
37	370	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.21
38	380	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.11
39	390	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.05
40	400	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.03
41	410	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.01
42	420	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.01
43	430	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
44	440	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
45	450	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
46	460	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
47	470	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
48	480	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00

Time = 8.0 hours

Total Volume of Runoff = 7470 cu. ft.*
0.17 ac-ft

* (Found by summing this column and multiplying by 600. 600 is the conversion required to convert SUM(Q) in cfs to total volume in cubic feet as follows:

V = SUM(Q) x dt
(cu.ft.) = (cu.ft/s) x (10 min.) x (60 s/min.)

Peak Hour Rainfall Intensity = 0.240 in/hr

Total Flowrate of Runoff = 0.92 cfs

LAKE SAN MARCOS ESTATES

Rational Method Results for Existing Area EX2

1) Time of Concentration, Tc = 17.7 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, Average C

C =	0.45	0.45	0.55
	Development Area (ac)		
	5.70	58.6	0.00

sum of areas	5.7	58.6	0.0	0.0	=	**64.30 ac.**
				weighted average C =		0.45

3) Then for Tc = 17.7 minutes

I_{100} =	3.74	in/hr	for P6	3.20	in.	then Q_{100} =	108	cfs	V_{100} =	7.72 ac-ft
I_{50} =	2.92	in/hr	for P6	2.50	in.	then Q_{50} =	84.5	cfs	V_{50} =	6.03 ac-ft
I_{10} =	2.45	in/hr	for P6	2.10	in.	then Q_{10} =	70.9	cfs	V_{10} =	5.06 ac-ft
I_2 =	1.69	in/hr	for P6	1.45	in.	then Q_2 =	49.0	cfs	V_2 =	3.50 ac-ft

LAKE SAN MARCOS ESTATES

Rational Method results at Developed Watershed 2

1) Time of Concentration, Tc = 18.9 minutes

At urban interface, Tc = 12.7 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, % Impervious

C =	0.55	0.55	0.55	0.45
Development Area (ac)				
	0.2	3.0	3.60	58.1

sum of areas	0.2	3.0	3.6	58.1	=	**64.9 ac.**
sum of areas at urban interface					=	**6.8 ac.**
% impervious	35	35	35	0		**35.0% impervious**
weighted average C =						0.46

3) Then for Tc = 18.9 minutes

I_{100} =	3.58	in/hr	for P6	3.20	in.	ıen Q_{100} =	107	cfs	V_{100} =	7.97 ac-ft
I_{50} =	2.80	in/hr	for P6	2.50	in.	ıen Q_{50} =	83.6	cfs	V_{50} =	6.23 ac-ft
I_{10} =	2.35	in/hr	for P6	2.10	in.	ıen Q_{10} =	70.3	cfs	V_{10} =	5.23 ac-ft
I_2 =	1.62	in/hr	for P6	1.45	in.	hen Q_2 =	48.5	cfs	V_2 =	3.61 ac-ft

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 2

RUNOFF HYDROGRAPH (SBUH METHOD - 6-Hour Storm Event)

Given:	Area	=	6.8	acres				
	Pt	=	0.72	inches (Total rainfall for an 85th percentile - 24 hour storm event)				
	dt	=	10.0	min.				
	Tc	=	12.7	min. (Developed site conditions)				
	% IMP =		35%					
	PERVIOUS Parcel				IMPERVIOUS Parcel			
	Area	=	4.4	acres	Area	=	2.4	acres
	CN	=	68		CN	=	98	(assuming dry antecedent moisture condition)
	S	=	4.71		S	=	0.20	
	0.2S	=	0.94		0.2S	=	0.04	

Compute Developed Conditions Runoff hydrograph

Column (3) = Rainfall Distribution for San Diego County
Column (4) = Col. (3) x Pt = 85th percentile - 6 Hour Hyetograph at this location.
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; use PERVIOUS Area "S" value. [If P > 0.2S] = $(\text{Col.}(5) - 0.2S)^2/(\text{Col.}(5) + 0.8S)$; use PERVIOUS Area "S" value.
Column (7) = Col.(6) of present time step - Col.(6) of previous time step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes); Routing Constant, w = dt / (2Tc + dt) = 0.2833
Column (12) = Col.(12) of previous time step + (w x [Col.(11) of previous time step + Col.(11) of present time step - (2 x Col.(12) of previous time step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs	
1	10	0.0166	0.0120	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
2	20	0.0166	0.0120	0.0239	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
3	30	0.0166	0.0120	0.0359	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
4	40	0.0200	0.0144	0.0503	0.0000	0.0000	0.0004	0.0004	0.0001	0.01	0.00	
5	50	0.0200	0.0144	0.0647	0.0000	0.0000	0.0025	0.0021	0.0007	0.03	0.01	
6	60	0.0200	0.0144	0.0791	0.0000	0.0000	0.0060	0.0035	0.0012	0.05	0.03	
7	70	0.0226	0.0163	0.0953	0.0000	0.0000	0.0115	0.0055	0.0019	0.08	0.05	
8	80	0.0226	0.0163	0.1116	0.0000	0.0000	0.0182	0.0067	0.0024	0.10	0.07	
9	90	0.0226	0.0163	0.1279	0.0000	0.0000	0.0260	0.0078	0.0027	0.11	0.09	
10	100	0.0334	0.0240	0.1519	0.0000	0.0000	0.0392	0.0131	0.0046	0.19	0.12	
11	110	0.0334	0.0240	0.1760	0.0000	0.0000	0.0538	0.0147	0.0051	0.21	0.17	
12	120	0.0334	0.0240	0.2000	0.0000	0.0000	0.0698	0.0159	0.0056	0.23	0.20	
13	130	0.0778	0.0560	0.2560	0.0000	0.0000	0.1105	0.0407	0.0142	0.59	0.32	
14	140	0.0778	0.0560	0.3120	0.0000	0.0000	0.1548	0.0443	0.0155	0.64	0.48	
15	150	0.0778	0.0560	0.3680	0.0000	0.0000	0.2015	0.0468	0.0164	0.67	0.58	**<<<peak**
16	160	0.0334	0.0240	0.3921	0.0000	0.0000	0.2222	0.0207	0.0072	0.30	0.53	
17	170	0.0334	0.0240	0.4161	0.0000	0.0000	0.2431	0.0209	0.0073	0.30	0.40	

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 2

(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
18	180	0.0334	0.0240	0.4402	0.0000	0.0000	0.2643	0.0212	0.0074	0.31	0.34
19	190	0.0316	0.0228	0.4629	0.0000	0.0000	0.2845	0.0202	0.0071	0.29	0.32
20	200	0.0316	0.0228	0.4857	0.0000	0.0000	0.3050	0.0204	0.0071	0.29	0.30
21	210	0.0316	0.0228	0.5084	0.0000	0.0000	0.3255	0.0206	0.0072	0.30	0.30
22	220	0.0234	0.0168	0.5253	0.0000	0.0000	0.3409	0.0153	0.0054	0.22	0.28
23	230	0.0234	0.0168	0.5421	0.0000	0.0000	0.3563	0.0154	0.0054	0.22	0.25
24	240	0.0233	0.0168	0.5589	0.0000	0.0000	0.3717	0.0154	0.0054	0.22	0.23
25	250	0.0213	0.0153	0.5742	0.0000	0.0000	0.3858	0.0141	0.0049	0.20	0.22
26	260	0.0213	0.0153	0.5896	0.0000	0.0000	0.4000	0.0142	0.0050	0.20	0.21
27	270	0.0213	0.0153	0.6049	0.0000	0.0000	0.4142	0.0142	0.0050	0.20	0.21
28	280	0.0175	0.0126	0.6175	0.0000	0.0000	0.4259	0.0117	0.0041	0.17	0.20
29	290	0.0175	0.0126	0.6301	0.0000	0.0000	0.4377	0.0118	0.0041	0.17	0.18
30	300	0.0175	0.0126	0.6427	0.0000	0.0000	0.4495	0.0118	0.0041	0.17	0.17
31	310	0.0183	0.0132	0.6559	0.0000	0.0000	0.4618	0.0123	0.0043	0.18	0.17
32	320	0.0183	0.0132	0.6691	0.0000	0.0000	0.4742	0.0124	0.0043	0.18	0.18
33	330	0.0183	0.0132	0.6822	0.0000	0.0000	0.4866	0.0124	0.0043	0.18	0.18
34	340	0.0175	0.0126	0.6948	0.0000	0.0000	0.4985	0.0119	0.0042	0.17	0.18
35	350	0.0175	0.0126	0.7074	0.0000	0.0000	0.5104	0.0119	0.0042	0.17	0.17
36	360	0.0175	0.0126	0.7200	0.0000	0.0000	0.5223	0.0119	0.0042	0.17	0.17
37	370	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.12
38	380	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.05
39	390	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.02
40	400	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.01
41	410	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
42	420	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
43	430	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
44	440	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
45	450	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
46	460	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
47	470	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
48	480	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00

Time = 8.0 hours

Total Volume of Runoff = 4512 cu. ft.*
0.10 ac-ft

Peak Hour Rainfall Intensity = 0.240 in/hr

Total Flowrate of Runoff = 0.58 cfs

* (Found by summing this column and multiplying by 600. 600 is the conversion required to convert SUM(Q) in cfs to total volume in cubic feet as follows:

V = SUM(Q) x dt
(cu.ft.) = (cu.ft/s) x (10 min.) x (60 s/min.)

LAKE SAN MARCOS ESTATES

Rational Method Results for Existing Area EX3

1) Time of Concentration, Tc = 19.9 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, Average C

C =	0.45	0.45	0.45
	Development Area (ac)		
	1.50	49.4	0.00

sum of areas	1.5	49.4	0.0	0.0	=	**50.90 ac.**
			weighted average C =			0.45

3) Then for Tc = 19.9 minutes

I_{100} =	3.46 in/hr	for	P6	3.20 in.	then Q_{100} =	79.3	cfs	V_{100} =	6.11	ac-ft
I_{50} =	2.70 in/hr	for	P6	2.50 in.	then Q_{50} =	61.9	cfs	V_{50} =	4.77	ac-ft
I_{10} =	2.27 in/hr	for	P6	2.10 in.	then Q_{10} =	52.0	cfs	V_{10} =	4.01	ac-ft
I_{2} =	1.57 in/hr	for	P6	1.45 in.	then Q_{2} =	35.9	cfs	V_{2} =	2.77	ac-ft

LAKE SAN MARCOS ESTATES

Rational Method results at Developed Watershed $\boxed{3}$

1) Time of Concentration, Tc = $\boxed{18.9}$ minutes

At urban interface, Tc = 15.4 minutes

From "Hydrology Study for Lake San Marcos Estates," September 19, 2000

2) Area, % Impervious

C =	0.55	0.55	0.55	0.45		
Development Area (ac)	0.2	3.7	6.90	36.8		
sum of areas	0.2	3.7	6.9	36.8	=	**47.6 ac.**
sum of areas at urban interface					=	**10.8 ac.**
% impervious	35	35	35	0		**35.0% impervious**
weighted average C =						0.47

3) Then for Tc = 18.9 minutes

I_{100} =	3.58	in/hr	for	P6	3.20	in.	then Q_{100} =	80.6	cfs	V_{100} =	6.00	ac-ft
I_{50} =	2.80	in/hr	for	P6	2.50	in.	then Q_{50} =	63.0	cfs	V_{50} =	4.69	ac-ft
I_{10} =	2.35	in/hr	for	P6	2.10	in.	then Q_{10} =	52.9	cfs	V_{10} =	3.94	ac-ft
I_{2} =	1.62	in/hr	for	P6	1.45	in.	then Q_{2} =	36.5	cfs	V_{2} =	2.72	ac-ft

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 3

RUNOFF HYDROGRAPH (SBUH METHOD - 6-Hour Storm Event)

Given: Area = 10.8 acres
Pt = 0.72 inches (Total rainfall for an 85th percentile - 24 hour storm event)
dt = 10.0 min.
Tc = 15.4 min. (Developed site conditions)
% IMP = 35%

PERVIOUS Parcel				IMPERVIOUS Parcel			
Area	=	7.0	acres	Area	=	3.8	acres
CN	=	68		CN	=	98	(assuming dry antecedent moisture condition)
S	=	4.71		S	=	0.20	
0.2S	=	0.94		0.2S	=	0.04	

Compute Developed Conditions Runoff hydrograph

Column (3) = Rainfall Distribution for San Diego County
Column (4) = Col. (3) x Pt = 85th percentile - 6 Hour Hyetograph at this location.
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; use PERVIOUS Area "S" value. [If P > 0.2S] = $(Col.(5) - 0.2S)^2/(Col.(5) + 0.8S)$; use PERVIOUS Area "S" value.
Column (7) = Col.(6) of present time step - Col.(6) of previous time step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes);Routing Constant, w = dt / (2Tc + dt) = 0.2451
Column (12) = Col.(12) of previous time step + (w x [Col.(11) of previous time step + Col.(11) of present time step - (2 x Col.(12) of previous time step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs	
1	10	0.0166	0.0120	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
2	20	0.0166	0.0120	0.0239	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
3	30	0.0166	0.0120	0.0359	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
4	40	0.0200	0.0144	0.0503	0.0000	0.0000	0.0004	0.0004	0.0001	0.01	0.00	
5	50	0.0200	0.0144	0.0647	0.0000	0.0000	0.0025	0.0021	0.0007	0.05	0.02	
6	60	0.0200	0.0144	0.0791	0.0000	0.0000	0.0060	0.0035	0.0012	0.08	0.04	
7	70	0.0226	0.0163	0.0953	0.0000	0.0000	0.0115	0.0055	0.0019	0.12	0.07	
8	80	0.0226	0.0163	0.1116	0.0000	0.0000	0.0182	0.0067	0.0024	0.15	0.10	
9	90	0.0226	0.0163	0.1279	0.0000	0.0000	0.0260	0.0078	0.0027	0.18	0.13	
10	100	0.0334	0.0240	0.1519	0.0000	0.0000	0.0392	0.0131	0.0046	0.30	0.19	
11	110	0.0334	0.0240	0.1760	0.0000	0.0000	0.0538	0.0147	0.0051	0.34	0.25	
12	120	0.0334	0.0240	0.2000	0.0000	0.0000	0.0698	0.0159	0.0056	0.36	0.30	
13	130	0.0778	0.0560	0.2560	0.0000	0.0000	0.1105	0.0407	0.0142	0.93	0.47	
14	140	0.0778	0.0560	0.3120	0.0000	0.0000	0.1548	0.0443	0.0155	1.01	0.72	
15	150	0.0778	0.0560	0.3680	0.0000	0.0000	0.2015	0.0468	0.0164	1.07	0.88	**<<<peak**
16	160	0.0334	0.0240	0.3921	0.0000	0.0000	0.2222	0.0207	0.0072	0.47	0.82	
17	170	0.0334	0.0240	0.4161	0.0000	0.0000	0.2431	0.0209	0.0073	0.48	0.65	

LAKE SAN MARCOS ESTATES - Storm Water Quality Facility Sizing for Watershed 3

(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
18	180	0.0334	0.0240	0.4402	0.0000	0.0000	0.2643	0.0212	0.0074	0.48	0.57
19	190	0.0316	0.0228	0.4629	0.0000	0.0000	0.2845	0.0202	0.0071	0.46	0.52
20	200	0.0316	0.0228	0.4857	0.0000	0.0000	0.3050	0.0204	0.0071	0.47	0.49
21	210	0.0316	0.0228	0.5084	0.0000	0.0000	0.3255	0.0206	0.0072	0.47	0.48
22	220	0.0234	0.0168	0.5253	0.0000	0.0000	0.3409	0.0153	0.0054	0.35	0.45
23	230	0.0234	0.0168	0.5421	0.0000	0.0000	0.3563	0.0154	0.0054	0.35	0.40
24	240	0.0233	0.0168	0.5589	0.0000	0.0000	0.3717	0.0154	0.0054	0.35	0.38
25	250	0.0213	0.0153	0.5742	0.0000	0.0000	0.3858	0.0141	0.0049	0.32	0.36
26	260	0.0213	0.0153	0.5896	0.0000	0.0000	0.4000	0.0142	0.0050	0.32	0.34
27	270	0.0213	0.0153	0.6049	0.0000	0.0000	0.4142	0.0142	0.0050	0.33	0.33
28	280	0.0175	0.0126	0.6175	0.0000	0.0000	0.4259	0.0117	0.0041	0.27	0.32
29	290	0.0175	0.0126	0.6301	0.0000	0.0000	0.4377	0.0118	0.0041	0.27	0.29
30	300	0.0175	0.0126	0.6427	0.0000	0.0000	0.4495	0.0118	0.0041	0.27	0.28
31	310	0.0183	0.0132	0.6559	0.0000	0.0000	0.4618	0.0123	0.0043	0.28	0.28
32	320	0.0183	0.0132	0.6691	0.0000	0.0000	0.4742	0.0124	0.0043	0.28	0.28
33	330	0.0183	0.0132	0.6822	0.0000	0.0000	0.4866	0.0124	0.0043	0.28	0.28
34	340	0.0175	0.0126	0.6948	0.0000	0.0000	0.4985	0.0119	0.0042	0.27	0.28
35	350	0.0175	0.0126	0.7074	0.0000	0.0000	0.5104	0.0119	0.0042	0.27	0.28
36	360	0.0175	0.0126	0.7200	0.0000	0.0000	0.5223	0.0119	0.0042	0.27	0.27
37	370	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.21
38	380	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.11
39	390	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.05
40	400	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.03
41	410	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.01
42	420	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.01
43	430	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
44	440	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
45	450	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
46	460	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
47	470	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00
48	480	0.0000	0.0000	0.7200	0.0000	0.0000	0.5223	0.0000	0.0000	0.00	0.00

Time = 8.0 hours

Total Volume of Runoff = 7166 cu. ft.*
0.16 ac-ft

Peak Hour Rainfall Intensity = 0.240 in/hr

Total Flowrate of Runoff = 0.88 cfs

* (Found by summing this column and multiplying by 600. 600 is the conversion required to convert SUM(Q) in cfs to total volume in cubic feet as follows:

V = SUM(Q) x dt
(cu.ft.) = (cu.ft/s) x (10 min.) x (60 s/min.)

LAKE SAN MARCOS ESTATES

HYDRAULIC ANALYSIS OF LOW FLOW DIVERSION & VORTECHS UNIT AT CLEANOUT (Node 100)

LOW FLOW ORIFICE (Q = 0.92 cfs)

Weir Formula for Orifices & Short Tubes (free & submerged)

$Q = Ca(2gh)^{0.5}$ (Eqn. 1)

$Q = Ca(64.32h)^{0.5}$; C = 0.56

$Q = 4.491\ a(h)^{0.5}$, where a = area of orifice opening,
h = head (ft) above centerline of orifice

Orifice Size, L = 6 in. , a = 0.21 sq. ft., invert elevation = 100.00 ft.
H = 5 in.

HIGH FLOW (Q_{100} = 30.8 cfs)

Weir Formula for Bypass Weir & Vortechs Weir

$Q = CLH^{1.5}$; C = 3.3 for Bypass (Eqn. 2)
6.2 for Vortechs

Bypass: L = 4.0 ft. @ elevation 101.17 ft. (1.17 ft.)
Vortechs: L = 1.0 ft. @ elevation 103.17 ft.

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
100.00	0.0	0.0	0.0	0.0	0.0	0.00	0.0
100.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.33	0.13	0.33	0.00	0.00	0.00	0.00	0.33
100.42	0.21	0.43	0.00	0.00	0.00	0.00	0.43
100.50	0.29	0.51	0.00	0.00	0.00	0.00	0.51
100.58	0.38	0.57	0.00	0.00	0.00	0.00	0.57
100.67	0.46	0.63	0.00	0.00	0.00	0.00	0.63
100.75	0.54	0.69	0.00	0.00	0.00	0.00	0.69
100.83	0.63	0.74	0.00	0.00	0.00	0.00	0.74
100.92	0.71	0.79	0.00	0.00	0.00	0.00	0.79
101.00	0.79	0.83	0.00	0.00	0.00	0.00	0.83
101.08	0.88	0.88	0.00	0.00	0.00	0.00	0.88
101.17	0.96	0.92	0.00	0.00	0.00	0.00	0.92
101.25	1.04	0.95	0.00	0.00	0.08	0.30	1.25
101.33	1.13	0.99	0.00	0.00	0.16	0.87	1.86
101.42	1.21	1.03	0.00	0.00	0.25	1.62	2.65
101.50	1.29	1.06	0.00	0.00	0.33	2.50	3.57
101.58	1.38	1.10	0.00	0.00	0.41	3.51	4.60
101.67	1.46	1.13	0.00	0.00	0.50	4.62	5.75
101.75	1.54	1.16	0.00	0.00	0.58	5.83	6.99
101.83	1.63	1.19	0.00	0.00	0.66	7.13	8.32
101.92	1.71	1.22	0.00	0.00	0.75	8.52	9.74
102.00	1.79	1.25	0.00	0.00	0.83	9.98	11.23
102.08	1.88	1.28	0.00	0.00	0.91	11.52	12.80
102.17	1.96	1.31	0.00	0.00	1.00	13.13	14.44
102.25	2.04	1.34	0.00	0.00	1.08	14.82	16.15
102.33	2.13	1.36	0.00	0.00	1.16	16.56	17.93
102.42	2.21	1.39	0.00	0.00	1.25	18.37	19.76
102.50	2.29	1.42	0.00	0.00	1.33	20.25	21.66

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
102.58	2.37	1.44	0.00	0.00	1.41	22.2	23.6
102.67	2.46	1.47	0.00	0.00	1.50	24.2	25.6
102.75	2.54	1.49	0.00	0.00	1.58	26.2	27.7
102.83	2.62	1.52	0.00	0.00	1.66	28.3	29.8
102.92	2.71	1.54	0.00	0.00	1.75	30.5	32.0
103.00	2.79	1.56	0.00	0.00	1.83	32.7	34.2
103.08	2.87	1.59	0.00	0.00	1.91	34.9	36.5
103.17	2.96	1.61	0.00	0.00	2.00	37.2	38.9
103.25	3.04	1.63	0.08	0.14	2.08	39.6	41.4
103.33	3.12	1.65	0.16	0.41	2.16	42.0	44.1
103.42	3.21	1.68	0.25	0.76	2.25	44.5	46.9
103.50	3.29	1.70	0.33	1.18	2.33	46.9	49.8
103.58	3.37	1.72	0.41	1.65	2.41	49.5	52.9
103.67	3.46	1.74	0.50	2.17	2.50	52.1	56.0
103.75	3.54	1.76	0.58	2.74	2.58	54.7	59.2
103.83	3.62	1.78	0.66	3.35	2.66	57.4	62.5
103.92	3.71	1.80	0.75	4.00	2.75	60.1	65.9
104.00	3.79	1.82	0.83	4.69	2.83	62.8	69.4
104.08	3.87	1.84	0.91	5.41	2.91	65.6	72.9
104.17	3.96	1.86	1.00	6.17	3.00	68.5	76.5
104.25	4.04	1.88	1.08	6.96	3.08	71.4	80.2
104.33	4.12	1.90	1.16	7.78	3.16	74.3	83.9
104.42	4.21	1.92	1.25	8.63	3.25	77.2	87.8
104.50	4.29	1.94	1.33	9.51	3.33	80.2	91.7
104.58	4.37	1.96	1.41	10.42	3.41	83.2	95.6
104.67	4.46	1.98	1.50	11.35	3.50	86.3	99.6
104.75	4.54	1.99	1.58	12.31	3.58	89.4	103.7
104.83	4.62	2.01	1.66	13.30	3.66	92.6	107.9
104.92	4.71	2.03	1.75	14.31	3.75	95.7	112.1
105.00	4.79	2.05	1.83	15.35	3.83	98.9	116.3

SO USE VORTECHS SYSTEM MODEL 1000

LAKE SAN MARCOS ESTATES

HYDRAULIC ANALYSIS OF LOW FLOW DIVERSION & VORTECHS UNIT AT CLEANOUT (Node 201)

LOW FLOW ORIFICE (Q = 0.58 cfs)

Weir Formula for Orifices & Short Tubes (free & submerged)

$Q = Ca(2gh)^{0.5}$ (Eqn. 1)

$Q = Ca(64.32h)^{0.5}$; $C = 0.56$

$Q = 4.491\ a(h)^{0.5}$, where a = area of orifice opening,
h = head (ft) above centerline of orifice

Orifice Size, L = 6 in. , a = 0.17 sq. ft., invert elevation = 100.00 ft.
H = 4 in.

HIGH FLOW (Q_{100} = 8.2 cfs)

Weir Formula for Bypass Weir & Vortechs Weir

$Q = CLH^{1.5}$; C = 3.3 for Bypass (Eqn. 2)
6.2 for Vortechs

Bypass: L = 4.0 ft. @ elevation 100.83 ft. (0.83 ft.)
Vortechs: L = 1.0 ft. @ elevation 102.83 ft.

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
100.00	0.0	0.0	0.0	0.0	0.0	0.00	0.0
100.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.33	0.17	0.31	0.00	0.00	0.00	0.00	0.31
100.42	0.25	0.37	0.00	0.00	0.00	0.00	0.37
100.50	0.33	0.43	0.00	0.00	0.00	0.00	0.43
100.58	0.42	0.48	0.00	0.00	0.00	0.00	0.48
100.67	0.50	0.53	0.00	0.00	0.00	0.00	0.53
100.75	0.58	0.57	0.00	0.00	0.00	0.00	0.57
100.83	0.67	0.61	0.00	0.00	0.00	0.00	0.61
100.92	0.75	0.65	0.00	0.00	0.09	0.34	0.99
101.00	0.83	0.68	0.00	0.00	0.17	0.93	1.61
101.08	0.92	0.72	0.00	0.00	0.25	1.68	2.40
101.17	1.00	0.75	0.00	0.00	0.34	2.58	3.33
101.25	1.08	0.78	0.00	0.00	0.42	3.59	4.37
101.33	1.17	0.81	0.00	0.00	0.50	4.71	5.52
101.42	1.25	0.84	0.00	0.00	0.59	5.93	6.77
101.50	1.33	0.86	0.00	0.00	0.67	7.24	8.10
101.58	1.42	0.89	0.00	0.00	0.75	8.63	9.52
101.67	1.50	0.92	0.00	0.00	0.84	10.10	11.02
101.75	1.58	0.94	0.00	0.00	0.92	11.65	12.59
101.83	1.67	0.97	0.00	0.00	1.00	13.27	14.23
101.92	1.75	0.99	0.00	0.00	1.09	14.95	15.94
102.00	1.83	1.01	0.00	0.00	1.17	16.71	17.72
102.08	1.92	1.04	0.00	0.00	1.25	18.52	19.56
102.17	2.00	1.06	0.00	0.00	1.34	20.40	21.46
102.25	2.08	1.08	0.00	0.00	1.42	22.34	23.42
102.33	2.17	1.10	0.00	0.00	1.50	24.33	25.43
102.42	2.25	1.12	0.00	0.00	1.59	26.38	27.50
102.50	2.33	1.14	0.00	0.00	1.67	28.49	29.63

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
102.58	2.42	1.16	0.00	0.00	1.75	30.6	31.8
102.67	2.50	1.18	0.00	0.00	1.84	32.9	34.0
102.75	2.58	1.20	0.00	0.00	1.92	35.1	36.3
102.83	2.67	1.22	0.00	0.00	2.00	37.4	38.7
102.92	2.75	1.24	0.09	0.16	2.09	39.8	41.2
103.00	2.83	1.26	0.17	0.43	2.17	42.2	43.9
103.08	2.92	1.28	0.25	0.79	2.25	44.6	46.7
103.17	3.00	1.30	0.34	1.21	2.34	47.1	49.7
103.25	3.08	1.31	0.42	1.69	2.42	49.7	52.7
103.33	3.17	1.33	0.50	2.21	2.50	52.3	55.8
103.42	3.25	1.35	0.59	2.79	2.59	54.9	59.0
103.50	3.33	1.37	0.67	3.40	2.67	57.6	62.4
103.58	3.42	1.38	0.75	4.05	2.75	60.3	65.7
103.67	3.50	1.40	0.84	4.74	2.84	63.1	69.2
103.75	3.58	1.42	0.92	5.47	2.92	65.9	72.8
103.83	3.67	1.43	1.00	6.23	3.00	68.7	76.4
103.92	3.75	1.45	1.09	7.02	3.09	71.6	80.1
104.00	3.83	1.47	1.17	7.85	3.17	74.5	83.8
104.08	3.92	1.48	1.25	8.70	3.25	77.5	87.6
104.17	4.00	1.50	1.34	9.58	3.34	80.5	91.5
104.25	4.08	1.51	1.42	10.49	3.42	83.5	95.5
104.33	4.17	1.53	1.50	11.43	3.50	86.6	99.5
104.42	4.25	1.54	1.59	12.39	3.59	89.7	103.6
104.50	4.33	1.56	1.67	13.38	3.67	92.8	107.7
104.58	4.42	1.57	1.75	14.39	3.75	96.0	112.0
104.67	4.50	1.59	1.84	15.43	3.84	99.2	116.2
104.75	4.58	1.60	1.92	16.49	3.92	102.4	120.5
104.83	4.67	1.62	2.00	17.58	4.00	105.7	124.9
104.92	4.75	1.63	2.09	18.69	4.09	109.1	129.4
105.00	4.83	1.65	2.17	19.82	4.17	112.4	133.9

SO USE VORTECHS SYSTEM MODEL 1000

LAKE SAN MARCOS ESTATES

HYDRAULIC ANALYSIS OF LOW FLOW DIVERSION & VORTECHS UNIT AT CLEANOUT (Node 301)

LOW FLOW ORIFICE (Q = 0.88 cfs)

Weir Formula for Orifices & Short Tubes (free & submerged)

$Q = Ca(2gh)^{0.5}$ (Eqn. 1)

$Q = Ca(64.32h)^{0.5}$; C = 0.56

$Q = 4.491\ a(h)^{0.5}$, where a = area of orifice opening,
h = head (ft) above centerline of orifice

Orifice Size, L = 6 in. , a = 0.21 sq. ft., invert elevation = 100.00 ft.
H = 5 in.

HIGH FLOW (Q_{100} = 24.9 cfs)

Weir Formula for Bypass Weir & Vortechs Weir

$Q = CLH^{1.5}$; C = 3.3 for Bypass (Eqn. 2)
6.2 for Vortechs

Bypass: L = 4.0 ft. @ elevation 101.08 ft. (1.08 ft.)
Vortechs: L = 1.0 ft. @ elevation 103.08 ft.

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
100.00	0.0	0.0	0.0	0.0	0.0	0.00	0.0
100.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.33	0.13	0.33	0.00	0.00	0.00	0.00	0.33
100.42	0.21	0.43	0.00	0.00	0.00	0.00	0.43
100.50	0.29	0.51	0.00	0.00	0.00	0.00	0.51
100.58	0.38	0.57	0.00	0.00	0.00	0.00	0.57
100.67	0.46	0.63	0.00	0.00	0.00	0.00	0.63
100.75	0.54	0.69	0.00	0.00	0.00	0.00	0.69
100.83	0.63	0.74	0.00	0.00	0.00	0.00	0.74
100.92	0.71	0.79	0.00	0.00	0.00	0.00	0.79
101.00	0.79	0.83	0.00	0.00	0.00	0.00	0.83
101.08	0.88	0.88	0.00	0.00	0.00	0.00	0.88
101.17	0.96	0.92	0.00	0.00	0.09	0.34	1.25
101.25	1.04	0.95	0.00	0.00	0.17	0.93	1.88
101.33	1.13	0.99	0.00	0.00	0.25	1.68	2.68
101.42	1.21	1.03	0.00	0.00	0.34	2.58	3.61
101.50	1.29	1.06	0.00	0.00	0.42	3.59	4.66
101.58	1.38	1.10	0.00	0.00	0.50	4.71	5.81
101.67	1.46	1.13	0.00	0.00	0.59	5.93	7.06
101.75	1.54	1.16	0.00	0.00	0.67	7.24	8.40
101.83	1.63	1.19	0.00	0.00	0.75	8.63	9.82
101.92	1.71	1.22	0.00	0.00	0.84	10.10	11.32
102.00	1.79	1.25	0.00	0.00	0.92	11.65	12.90
102.08	1.88	1.28	0.00	0.00	1.00	13.27	14.55
102.17	1.96	1.31	0.00	0.00	1.09	14.95	16.26
102.25	2.04	1.34	0.00	0.00	1.17	16.71	18.04
102.33	2.13	1.36	0.00	0.00	1.25	18.52	19.89
102.42	2.21	1.39	0.00	0.00	1.34	20.40	21.79
102.50	2.29	1.42	0.00	0.00	1.42	22.34	23.75

	Lo Flow (Eq. 1)		Weir Flow (Eq. 2)				
ELEV.	Orifice		Vortechs		Bypass		TOTAL
(feet)	h (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Q (cfs)
102.58	2.37	1.44	0.00	0.00	1.50	24.3	25.8
102.67	2.46	1.47	0.00	0.00	1.59	26.4	27.8
102.75	2.54	1.49	0.00	0.00	1.67	28.5	30.0
102.83	2.62	1.52	0.00	0.00	1.75	30.6	32.2
102.92	2.71	1.54	0.00	0.00	1.84	32.9	34.4
103.00	2.79	1.56	0.00	0.00	1.92	35.1	36.7
103.08	2.87	1.59	0.00	0.00	2.00	37.4	39.0
103.17	2.96	1.61	0.09	0.16	2.09	39.8	41.6
103.25	3.04	1.63	0.17	0.43	2.17	42.2	44.3
103.33	3.12	1.65	0.25	0.79	2.25	44.6	47.1
103.42	3.21	1.68	0.34	1.21	2.34	47.1	50.0
103.50	3.29	1.70	0.42	1.69	2.42	49.7	53.1
103.58	3.37	1.72	0.50	2.21	2.50	52.3	56.2
103.67	3.46	1.74	0.59	2.79	2.59	54.9	59.4
103.75	3.54	1.76	0.67	3.40	2.67	57.6	62.8
103.83	3.62	1.78	0.75	4.05	2.75	60.3	66.1
103.92	3.71	1.80	0.84	4.74	2.84	63.1	69.6
104.00	3.79	1.82	0.92	5.47	2.92	65.9	73.2
104.08	3.87	1.84	1.00	6.23	3.00	68.7	76.8
104.17	3.96	1.86	1.09	7.02	3.09	71.6	80.5
104.25	4.04	1.88	1.17	7.85	3.17	74.5	84.2
104.33	4.12	1.90	1.25	8.70	3.25	77.5	88.1
104.42	4.21	1.92	1.34	9.58	3.34	80.5	92.0
104.50	4.29	1.94	1.42	10.49	3.42	83.5	95.9
104.58	4.37	1.96	1.50	11.43	3.50	86.6	99.9
104.67	4.46	1.98	1.59	12.39	3.59	89.7	104.0
104.75	4.54	1.99	1.67	13.38	3.67	92.8	108.2
104.83	4.62	2.01	1.75	14.39	3.75	96.0	112.4
104.92	4.71	2.03	1.84	15.43	3.84	99.2	116.7
105.00	4.79	2.05	1.92	16.49	3.92	102.4	121.0

SO USE VORTECHS SYSTEM MODEL 1000

APPENDIX B

Hydrology Study for Lake San Marcos Estates

HUNSAKER
& ASSOCIATES
SAN DIEGO, INC.

PLANNING
ENGINEERING
SURVEYING

IRVINE
RIVERSIDE
SAN DIEGO

HYDROLOGY STUDY
for
LAKE SAN MARCOS ESTATES

City of San Marcos, California

Prepared for: D.R. Horton
1010 South Coast Highway 101
Suite 101
Encinitas, CA 92024

W.O. 1375-57

September 19, 2000

DAVE HAMMAR
JACK HILL
LEX WILLIMAN
ALISA VIALPANDO

Tomas E. Romero, R.C.E.
Project Manager
Hunsaker & Associates San Diego, Inc.

REGISTERED PROFESSIONAL ENGINEER
TOMAS EDULFO ROMERO
NO. 29648
Exp. 3/31/03
CIVIL
STATE OF CALIFORNIA

10179 Huennekens St.
San Diego, CA 92121
(858) 558-4500 PH
(858) 558-1414 FX
www.hunsaker.com
Info@HunsakerSD.com

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Introduction

Lake San Marcos Estates is a proposed single-family residential development community located east of Rancho Santa Fe Road and just west of Lake San Marcos in the City of San Marcos, California (see Vicinity Map below). Runoff from the site discharges to one of three outlet locations.

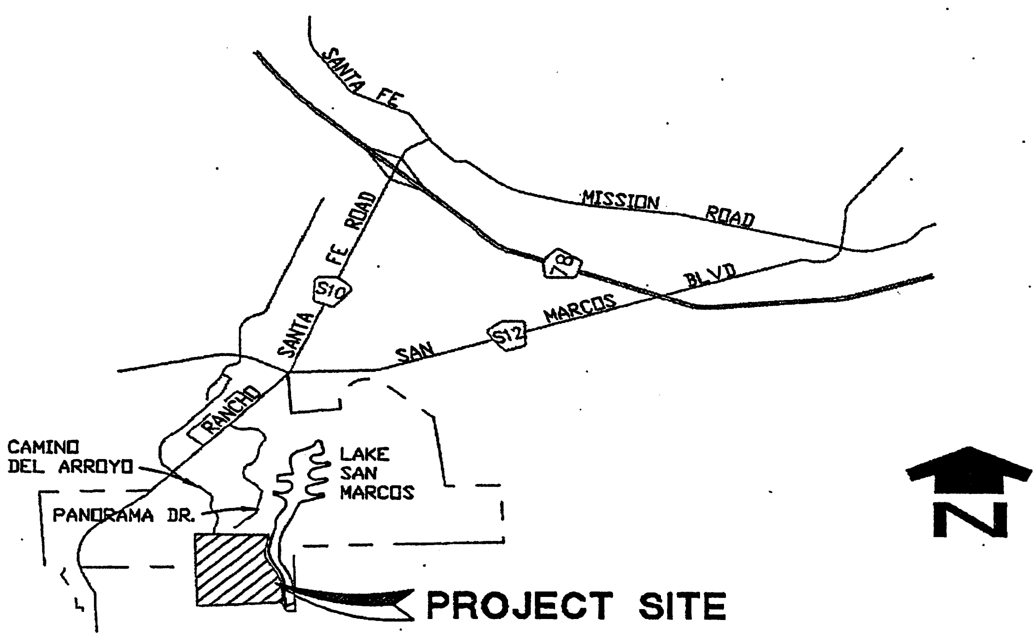
- Watershed No. 1 – flow to the western property boundary
- Watershed No. 2 – flow to the southern property boundary
- Watershed No. 3 – flow to the eastern property boundary

Construction of Lake San Marcos Estates will involve the development of 27 of the project site's 127 total acres. Grading of the site will not significantly alter existing drainage basin divides. This study predicts 100-year peak flowrates to each of the watershed outlets for existing and developed conditions.

LAKE SAN MARCOS ESTATES

VICINITY MAP

NOT TO SCALE



Summary of Results

Table 1 below summarizes the existing condition drainage areas and flows from the Lake San Marcos Estates site. Calculations are based on the AES-99 computer program (see Section III) and criteria set forth in the City of San Marcos' Master Plan of Drainage. Watershed delineations are visually depicted on the Existing Condition Hydrology Map, which is located in the back pocket of this report.

TABLE 1
Existing Condition Hydrologic Results

Basin	Drainage Area (acres)	100-Year Peak Flow (cfs)	cfs/acre
Watershed No. 1	11.7	23.8	2.2
Watershed No. 2	64.3	110.9	1.7
Watershed No. 3	50.9	80.4	1.6
Total	**126.9**	**215.1**	**1.7**

Table 2 below summarizes the developed condition areas and flows to the three watershed outlets (AES data located in Section IV of this report). Watershed delineations are depicted on the Developed Condition Hydrology Map in the back pocket of this report.

TABLE 2
Developed Condition Hydrologic Results

Basin	Drainage Area (acres)	100-Year Peak Flow (cfs)	cfs/acre	Peak Flow Difference* (cfs)
Watershed 1	14.4	31.5	2.2	+7.7
Watershed 2	64.9	110.8	1.7	-0.1
Watershed 3	47.6	86.8	1.8	+6.4
Total	**126.9**	**229.1**	**1.8**	**+14.0**

* As compared to existing conditions

Calculations show that development of the Lake San Marcos Estates site would result in a 6 percent increase in the total 100-year runoff from the site.

References

Drainage Design & Procedure Manual. County of San Diego, California, Updated April 1993.

Master Plan of Drainage. City of San Marcos, California, January 1990.

METHODOLOGY & MODEL DEVELOPMENT

City of San Marcos Drainage Design Criteria

The design criteria, as found in the County of San Diego Department of Public Works Flood Control Division Hydrology Manual, specifies the design runoff conditions within the San Diego County Flood Control District will be based on the 100 year storm frequency as follows:

1) Design for areas over 1 square mile will be based on the 100 year frequency storm.
2) For areas under 1 square mile –
    a. The storm drain system shall be designed so that the combination of storm drain system capacity and overflow both inside and outside the right of way will be able to carry the 100 year frequency storm without damaging adjacent existing buildings or potential building sites.
    b. The storm drain system shall be designed so that the combination of storm drain system capacity and allowable street overflow will be able to carry the 50 year frequency storm without damaging adjacent property.
    c. Where a storm drain is required under headings 1 or 2 above, then as a minimum, the drain shall be designed to carry the 10-year frequency storm.
3) Sump areas are to be designed for a sump capacity or outfall of a 100-year frequency storm.

Rational Method Hydrologic Analysis

Computer Software Package – AES-99

Design Storm - 100-year return interval

Land Use – Single Family Residential in developed areas

Soil Type - Hydrologic soil group D was assumed for all areas. Group D soils have very slow infiltration rates when thoroughly wetted. Consisting chiefly of clay soils with a high swelling potential, soils with a high permanent water table, soils with clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials, Group D soils have a very slow rate of water transmission.

Runoff Coefficient – In accordance with the County of San Diego standards, single-family residential areas were designated a runoff coefficient of 0.55 while natural areas were designated a runoff coefficient of 0.45.

Method of Analysis – The Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas with drainage areas less than 0.5 square miles, the Rational Method relates storm rainfall intensity, a runoff coefficient, and drainage area to peak runoff rate. This relationship is expressed by the equation:

Q = CIA, where:

Q = The peak runoff rate in cubic feet per second at the point of analysis.

C = A runoff coefficient representing the area - averaged ratio of runoff to rainfall intensity.

I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.

A = The drainage basin area in acres.

To perform a node-link study, the total watershed area is divided into subareas which discharge at designated nodes.

The procedure for the subarea summation model is as follows:

(1) Subdivide the watershed into an initial subarea (generally 1 lot) and subsequent subareas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each subarea.

(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation.

(3) Using the initial T_c, determine the corresponding values of I. Then Q = C I A.

(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES-99 computer subarea menu is as follows:

SUBAREA HYDROLOGIC PROCESS

1. Confluence analysis at node.
2. Initial subarea analysis (including time of concentration calculation).

3. Pipeflow travel time (computer estimated).
4. Pipeflow travel time (user specified).
5. Trapezoidal channel travel time.
6. Street flow analysis through subarea.
7. User - specified information at node.
8. Addition of subarea runoff to main line.
9. V-gutter flow through area.
10. Copy main stream data to memory bank
11. Confluence main stream data with a memory bank
12. Clear a memory bank

At the confluence point of two or more basins, the following procedure is used to combine peak flow rates to account for differences in the basin's times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1). If the collection streams have the same times of concentration, then the Q values are directly summed,

$Q_p = Q_a + Q_b$; $T_p = T_a = T_b$

(2). If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:

(i). The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q value is adjusted by the ratio of rainfall intensities.

$Q_p = Q_a + Q_b\ (I_a/I_b)$; $T_p = T_a$

(ii). In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by a ratio of the T values.

$Q_p = Q_b + Q_a\ (T_b/T_a)$; $T_p = T_b$

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

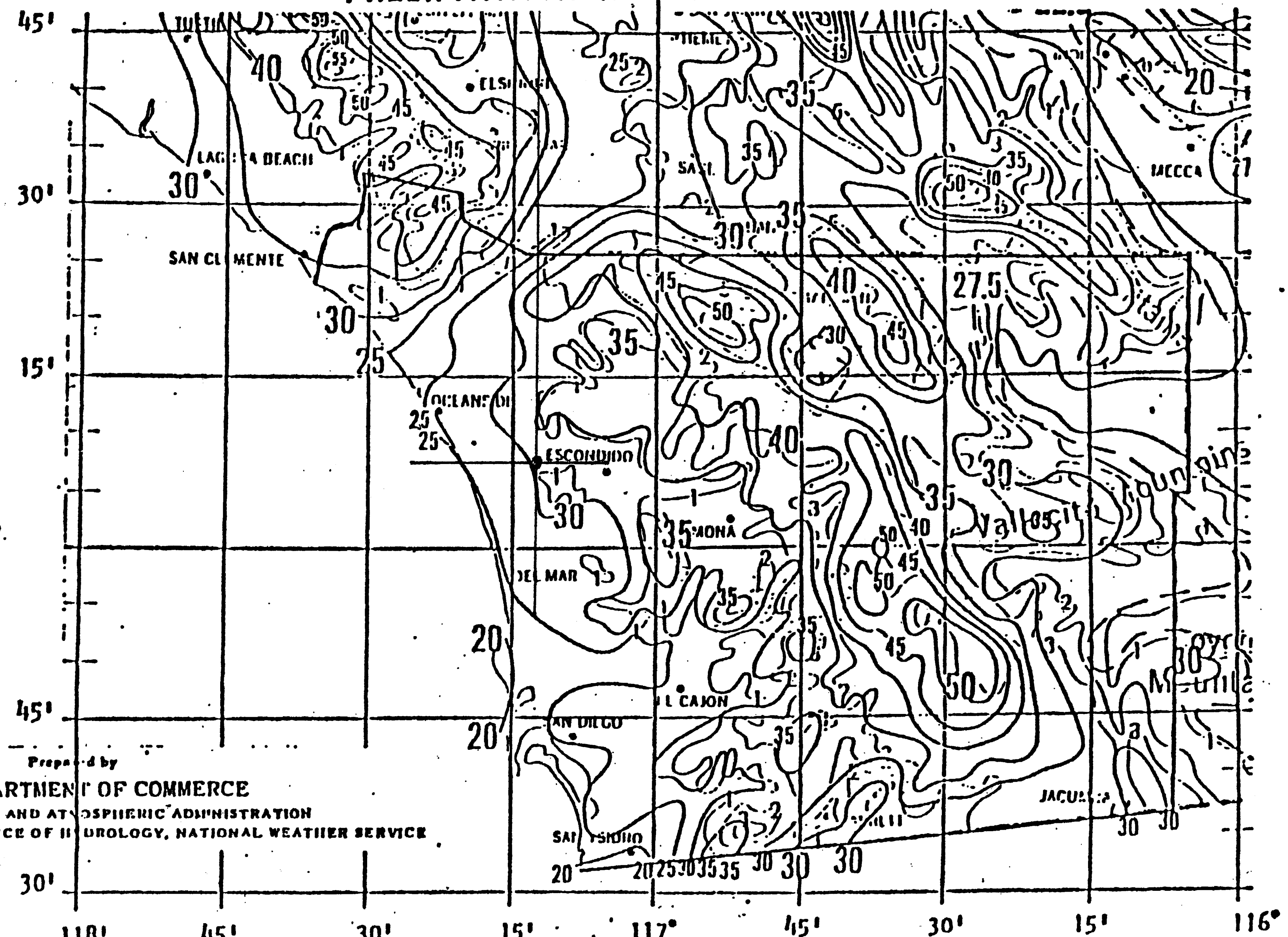
100-YEAR 6-HOUR PRECIPITATION

~20~ ISOPLUVIALS OF 100-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH

LATITUDE = 33-07

LONGITUDE = 117-13

$P_{100,6}$ = 3.2 INCHES



Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

111

Table 4 - 2

Rational Method Runoff Coefficients

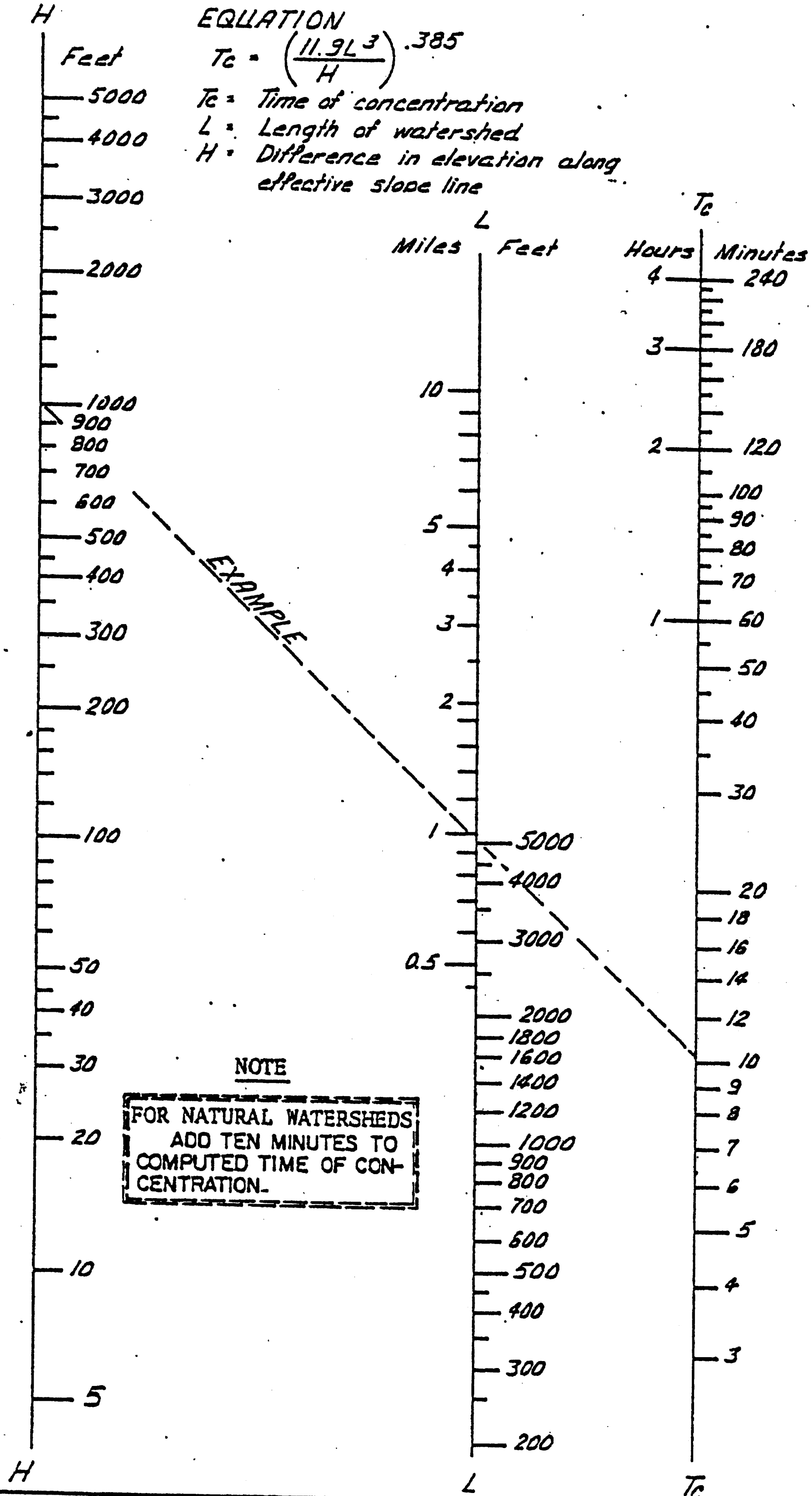
Land Use	General Plan Designation	Coefficient C Soil Group A	B	C	D
Residential:					
Single Family	2-8 DU/AC	.40	.45	.50	.55
Multi Units	8-30 DU/AC	.45	.50	.60	.70
Mobile Homes	Mobile Homes	.45	.50	.55	.65
Rural	Agricultural, Rural and Estate Residential	.30	.35	.40	.45
Commercial:	Commercial	.70	.75	.80	.85
Industrial:	Manufacturing	.80	.85	.90	.95

4) The 100 year 6-hour and 24-hour precipitation values were taken from the County of San Diego Department of Public Works Flood Control Division Hydrology Manual, Section II-A. (See Figure 4 - 3 and 4 - 4).

5) Rainfall intensities for the Rational Method hydrology computations were taken from the County of San Diego Department of Public Works Flood Control Division Hydrology Manual, Appendix XI.

6) Watershed boundaries and grades for proposed storm drains were derived from 400 scale orthophoto maps with 5 foot contour prepared by Rick Engineering Incorporated, San Diego, California.

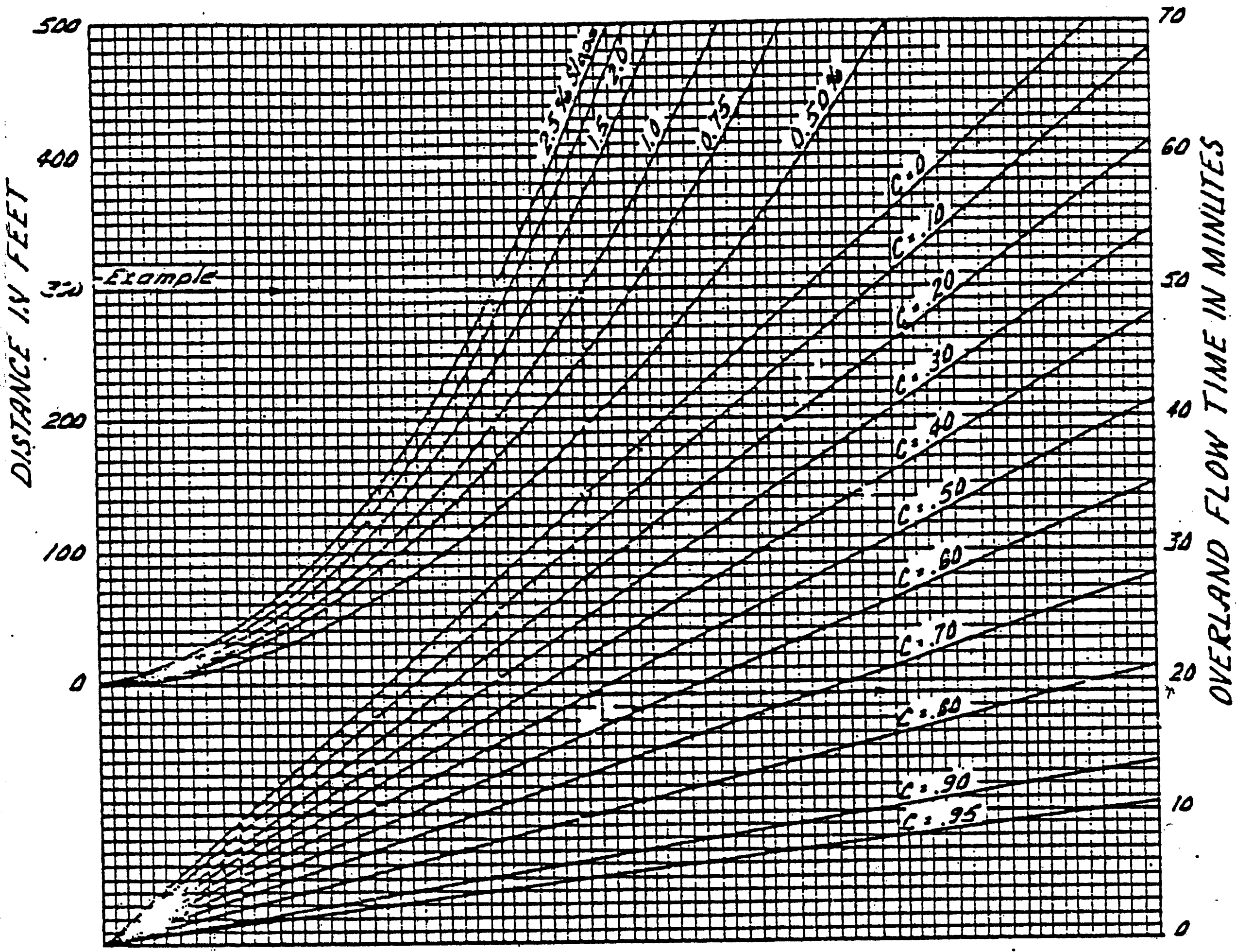
7) A number of major creeks have been identified in the City of San Marcos. Previous hydrologic studies conducted by Federal, County and private institutions have established 100 year peak flows for these major watercourses. Table 3 lists the studies available to the Master Drainage Plan Study as follows:



SAN DIEGO COUNTY DEPARTMENT OF SPECIAL DISTRICT SERVICES DESIGN MANUAL APPROVED B. H. Hoffmeister	NOMOGRAPH FOR DETERMINATION OF TIME OF CONCENTRATION (Tc) FOR NATURAL WATERSHEDS DATE 12/1/69

FIGURE 4 - 1

URBAN AREAS OVERLAND TIME OF FLOW CURVES



Example:
Given: Length of Flow = 300 ft.
Slope = 1.0 %
Coefficient of Runoff. C = .50
Read: Overland Flowtime = 19 Minutes

SAN DIEGO COUNTY DEPARTMENT OF SPECIAL DISTRICT SERVICES DESIGN MANUAL APPROVED [signature]	URBAN AREAS OVERLAND TIME OF FLOW CURVES DATE 12/1/69 — FIGURE 4 - 2

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

WATERSHED NO. 1

EXISTING CONDITIONS

DRAINAGE AREA	11.7 acres
	0.018 mi^2

Single-Family Residential Area C = 0.55	0.0 acres
Multi-Family Residential Area C = 0.70	0.0 acres
Commercial Area C = 0.85	0.0 acres
Open Area C = 0.45	11.7 acres

RUNOFF COEFFICIENT	0.45

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

<u>WATERSHED NO. 2</u>

EXISTING CONDITIONS

DRAINAGE AREA	**64.3**	**acres**
	0.100	mi^2

Single-Family Residential Area C = 0.55	0.0	acres
Multi-Family Residential Area C = 0.70	0.0	acres
Commercial Area C = 0.85	0.0	acres
Open Area C = 0.45	64.3	acres

RUNOFF COEFFICIENT	**0.45**

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

<u>WATERSHED NO. 3</u>

EXISTING CONDITIONS

DRAINAGE AREA	**50.9**	**acres**
	0.080	mi^2

Single-Family Residential Area C = 0.55	0.0	acres
Multi-Family Residential Area C = 0.70	0.0	acres
Commercial Area C = 0.85	0.0	acres
Open Area C = 0.45	50.9	acres

RUNOFF COEFFICIENT	**0.45**

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

<u>WATERSHED NO. 1</u>

DEVELOPED CONDITIONS

DRAINAGE AREA	**14.4**	**acres**
	0.023	mi^2

Single-Family Residential Area C = 0.55	9.6	acres
Multi-Family Residential Area C = 0.70	0.0	acres
Commercial Area C = 0.85	0.0	acres
Open Area C = 0.45	4.8	acres

RUNOFF COEFFICIENT	**0.52**

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

WATERSHED NO. 2

DEVELOPED CONDITIONS

DRAINAGE AREA	**64.9**	**acres**
	0.101	mi^2
Single-Family Residential Area C = 0.55	6.8	acres
Multi-Family Residential Area C = 0.70	0.0	acres
Commercial Area C = 0.85	0.0	acres
Open Area C = 0.45	58.1	acres
RUNOFF COEFFICIENT	**0.46**	

HYDROLOGIC DATA SHEET
HUNSAKER & ASSOCIATES - SAN DIEGO

Lake San Marcos Estates
W.O. 1375-57

WATERSHED NO. 3

DEVELOPED CONDITIONS

DRAINAGE AREA	**47.6**	**acres**
	0.074	mi^2

Single-Family Residential Area C = 0.55	10.8	acres
Multi-Family Residential Area C = 0.70	0.0	acres
Commercial Area C = 0.85	0.0	acres
Open Area C = 0.45	36.8	acres

RUNOFF COEFFICIENT	**0.47**

Runoff from Existing Basins

```
****************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                      1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-99 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/99  License ID 1239

                        Analysis prepared by:

                 Hunsaker & Associates San Diego, Inc.
                        10179 Huennekens Street
                 San Diego,  California  (619) 558-4500
                 Planning     Engineering    Surveying

************************** DESCRIPTION OF STUDY **************************
* LAKE SAN MARCOS ESTATES                                                *
* 100-Year Design Storm                                                  *
* Existing Conditions                                                    *
**************************************************************************

  FILE NAME: H:\AES99\1375\57\EX\EX.DAT
  TIME/DATE OF STUDY: 13:40   7/29/2000
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  1985 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.200
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


****************************************************************************
  FLOW PROCESS FROM NODE   101.00 TO NODE   100.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RURAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
  NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
  WITH 10-MINUTES ADDED =  13.16(MINUTES)
  INITIAL SUBAREA FLOW-LENGTH =   980.00
  UPSTREAM ELEVATION =    799.00
  DOWNSTREAM ELEVATION =    640.00
  ELEVATION DIFFERENCE =    159.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.516
  SUBAREA RUNOFF(CFS) =     23.78
  TOTAL AREA(ACRES) =     11.70   TOTAL RUNOFF(CFS) =     23.78


****************************************************************************
  FLOW PROCESS FROM NODE   202.00 TO NODE   201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
```

*USER SPECIFIED(SUBAREA):
""RAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
.TURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
WITH 10-MINUTES ADDED = 11.82(MINUTES)
INITIAL SUBAREA FLOW-LENGTH = 600.00
'STREAM ELEVATION = 793.00
..WNSTREAM ELEVATION = 640.00
ELEVATION DIFFERENCE = 153.00
.00 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.840
JBAREA RUNOFF(CFS) = 12.42
TOTAL AREA(ACRES) = 5.70 TOTAL RUNOFF(CFS) = 12.42

****

FLOW PROCESS FROM NODE 201.00 TO NODE 200.00 IS CODE = 53

..>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA<<<<<

==

'STREAM NODE ELEVATION = 640.00
DOWNSTREAM NODE ELEVATION = 498.00
"IANNEL LENGTH THRU SUBAREA(FEET) = 1430.00
IANNEL SLOPE = 0.0993
CHANNEL FLOW THRU SUBAREA(CFS) = 12.42
SLOPE ADJUSTMENT CURVE USED: EFFECTIVE SLOPE = 0.0993 (PER PLATE D-6.2)
.OW VELOCITY(FEET/SEC) = 4.08 (PER PLATE D-6.3)
RAVEL TIME(MIN.) = 5.84 TC(MIN.) = 17.66

****

FLOW PROCESS FROM NODE 201.00 TO NODE 200.00 IS CODE = 8

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

==

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.736
JSER SPECIFIED(SUBAREA):
JRAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
SUBAREA AREA(ACRES) = 58.60 SUBAREA RUNOFF(CFS) = 98.52
)TAL AREA(ACRES) = 64.30 TOTAL RUNOFF(CFS) = 110.94
:(MIN) = 17.66

****

.LOW PROCESS FROM NODE 302.00 TO NODE 301.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

==

*USER SPECIFIED(SUBAREA):
"JRAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
ATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)
WITH 10-MINUTES ADDED = 10.88(MINUTES)
INITIAL SUBAREA FLOW-LENGTH = 250.00
PSTREAM ELEVATION = 713.00
.OWNSTREAM ELEVATION = 640.00
ELEVATION DIFFERENCE = 73.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 5.106
JBAREA RUNOFF(CFS) = 3.45
TOTAL AREA(ACRES) = 1.50 TOTAL RUNOFF(CFS) = 3.45

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    300.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION =     640.00
  DOWNSTREAM NODE ELEVATION =     503.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1420.00
  CHANNEL SLOPE =  0.0965
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.45
  SLOPE ADJUSTMENT CURVE USED: EFFECTIVE SLOPE =  0.0965 (PER PLATE D-6.2)
  FLOW VELOCITY(FEET/SEC) =   2.63 (PER PLATE D-6.3)
  TRAVEL TIME(MIN.) =    9.01    TC(MIN.) =  19.89

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    300.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.460
  *USER SPECIFIED(SUBAREA):
  RURAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
  SUBAREA AREA(ACRES) =    49.40   SUBAREA RUNOFF(CFS) =    76.92
  TOTAL AREA(ACRES) =     50.90   TOTAL RUNOFF(CFS) =    80.36
  TC(MIN) =   19.89
============================================================================
  END OF STUDY SUMMARY:
  PEAK FLOW RATE(CFS) =      80.36   Tc(MIN.) =    19.89
  TOTAL AREA(ACRES) =      50.90
============================================================================
  END OF RATIONAL METHOD ANALYSIS

1
```

Runoff from Proposed Basins

```
****************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                     1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-99 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/99  License ID 1239

                        Analysis prepared by:

                 Hunsaker & Associates San Diego, Inc.
                        10179 Huennekens Street
                 San Diego,  California  (619) 558-4500
                 Planning     Engineering    Surveying

 ************************** DESCRIPTION OF STUDY **************************
 * LAKE SAN MARCOS ESTATES                                                  *
 * 100-Year Design Storm                                                    *
 * Developed Conditions                                                     *
 ****************************************************************************

  FILE NAME: H:\AES99\1375\57\DEV\DEV.DAT
  TIME/DATE OF STUDY: 19:40   7/29/2000
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  1985 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.200
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


****************************************************************************
  FLOW PROCESS FROM NODE   103.00 TO NODE   102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
  INITIAL SUBAREA FLOW-LENGTH =   100.00
  UPSTREAM ELEVATION =    774.00
  DOWNSTREAM ELEVATION =    773.00
  ELEVATION DIFFERENCE =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    9.900
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.427
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.60


****************************************************************************
  FLOW PROCESS FROM NODE   102.00 TO NODE   101.00 IS CODE =   6
----------------------------------------------------------------------------
  >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM ELEVATION =    773.00   DOWNSTREAM ELEVATION =    742.00
```

```
STREET LENGTH(FEET) =   900.00   CURB HEIGHT(INCHES) = 6.
STREET HALFWIDTH(FEET) = 18.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =   9.00
INTERIOR STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =    4.54
  STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =  0.33
       HALFSTREET FLOODWIDTH(FEET) =   10.01
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.05
       PRODUCT OF DEPTH&VELOCITY =    1.32
STREETFLOW TRAVELTIME(MIN) =   3.70   TC(MIN) =  13.60

 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.422
*USER SPECIFIED(SUBAREA):
SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
SUBAREA AREA(ACRES) =    3.20   SUBAREA RUNOFF(CFS) =    7.78
SUMMED AREA(ACRES) =    3.40   TOTAL RUNOFF(CFS) =      8.38
END OF SUBAREA STREETFLOW HYDRAULICS:
DEPTH(FEET) = 0.38   HALFSTREET FLOODWIDTH(FEET) = 12.59
FLOW VELOCITY(FEET/SEC.) =  4.92   DEPTH*VELOCITY =   1.86


****************************************************************************
 FLOW PROCESS FROM NODE   101.00 TO NODE   100.00 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.8 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  13.8
 UPSTREAM NODE ELEVATION =   732.00
 DOWNSTREAM NODE ELEVATION =   631.00
 FLOWLENGTH(FEET) =  1300.00   MANNING'S N = 0.013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      8.38
 TRAVEL TIME(MIN.) =   1.58    TC(MIN.) =  15.17


****************************************************************************
 FLOW PROCESS FROM NODE   101.00 TO NODE   100.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.120
 *USER SPECIFIED(SUBAREA):
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5100
 SUBAREA AREA(ACRES) =    11.00   SUBAREA RUNOFF(CFS) =   23.11
 TOTAL AREA(ACRES) =    14.40   TOTAL RUNOFF(CFS) =   31.49
 TC(MIN) =  15.17


****************************************************************************
 FLOW PROCESS FROM NODE   204.00 TO NODE   203.00 IS CODE =  21
----------------------------------------------------------------------------
```

```
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
 *USER SPECIFIED(SUBAREA):
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
 INITIAL SUBAREA FLOW-LENGTH =   100.00
 UPSTREAM ELEVATION =     774.00
 DOWNSTREAM ELEVATION =     773.00
 ELEVATION DIFFERENCE =       1.00
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =     9.900
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 5.427
 SUBAREA RUNOFF(CFS) =       0.60
 TOTAL AREA(ACRES) =       0.20   TOTAL RUNOFF(CFS) =       0.60


**************************************************************************
 FLOW PROCESS FROM NODE   203.00 TO NODE   202.00 IS CODE =   6
--------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
==========================================================================
 UPSTREAM ELEVATION =     773.00   DOWNSTREAM ELEVATION =     745.00
 STREET LENGTH(FEET) =    720.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 18.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =   9.00
 INTERIOR STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     4.44
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =  0.32
       HALFSTREET FLOODWIDTH(FEET) =     9.49
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.36
       PRODUCT OF DEPTH&VELOCITY =     1.38
 STREETFLOW TRAVELTIME(MIN) =    2.75    TC(MIN) =  12.65

  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.632
 *USER SPECIFIED(SUBAREA):
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
 SUBAREA AREA(ACRES) =     3.00   SUBAREA RUNOFF(CFS) =     7.64
 SUMMED AREA(ACRES) =     3.20   TOTAL RUNOFF(CFS) =      8.24
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) = 0.38   HALFSTREET FLOODWIDTH(FEET) = 12.59
 FLOW VELOCITY(FEET/SEC.) =  4.84   DEPTH*VELOCITY =   1.83


**************************************************************************
 FLOW PROCESS FROM NODE   202.00 TO NODE   201.00 IS CODE =   3
--------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.3 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =    7.1
 UPSTREAM NODE ELEVATION =    735.00
 DOWNSTREAM NODE ELEVATION =    731.00
 FLOWLENGTH(FEET) =    300.00   MANNING'S N = 0.013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      8.24
```

```
TRAVEL TIME(MIN.) =   0.71    TC(MIN.) =  13.36


****************************************************************************
  FLOW PROCESS FROM NODE   202.00 TO NODE   201.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.473
  *USER SPECIFIED(SUBAREA):
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
  SUBAREA AREA(ACRES) =     3.60   SUBAREA RUNOFF(CFS) =    8.86
  TOTAL AREA(ACRES) =     6.80   TOTAL RUNOFF(CFS) =    17.10
  TC(MIN) =  13.36


****************************************************************************
  FLOW PROCESS FROM NODE   201.00 TO NODE   200.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION =     731.00
  DOWNSTREAM NODE ELEVATION =     498.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1690.00
  CHANNEL SLOPE =  0.1379
  CHANNEL FLOW THRU SUBAREA(CFS) =      17.10
  SLOPE ADJUSTMENT CURVE USED: EFFECTIVE SLOPE =  0.1269 (PER PLATE D-6.2)
  FLOW VELOCITY(FEET/SEC) =   5.13 (PER PLATE D-6.3)
  TRAVEL TIME(MIN.) =   5.49    TC(MIN.) =  18.85


****************************************************************************
  FLOW PROCESS FROM NODE   201.00 TO NODE   200.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.583
  *USER SPECIFIED(SUBAREA):
  RURAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
  SUBAREA AREA(ACRES) =    58.10   SUBAREA RUNOFF(CFS) =    93.67
  TOTAL AREA(ACRES) =     64.90   TOTAL RUNOFF(CFS) =   110.76
  TC(MIN) =  18.85


****************************************************************************
  FLOW PROCESS FROM NODE   304.00 TO NODE   303.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
  INITIAL SUBAREA FLOW-LENGTH =    100.00
  UPSTREAM ELEVATION =     757.00
  DOWNSTREAM ELEVATION =     756.00
  ELEVATION DIFFERENCE =        1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =     9.900
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.427
  SUBAREA RUNOFF(CFS) =       0.60
  TOTAL AREA(ACRES) =       0.20   TOTAL RUNOFF(CFS) =       0.60
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   303.00 TO NODE   302.00 IS CODE =   6
----------------------------------------------------------------------------
  >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM ELEVATION =     756.00   DOWNSTREAM ELEVATION =     724.00
  STREET LENGTH(FEET) =  1000.00   CURB HEIGHT(INCHES) = 6.
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =   9.00
  INTERIOR STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

        **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     5.04
    STREETFLOW MODEL RESULTS:
        STREET FLOWDEPTH(FEET) =  0.34
        HALFSTREET FLOODWIDTH(FEET) =   10.52
        AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.11
        PRODUCT OF DEPTH&VELOCITY =    1.39
  STREETFLOW TRAVELTIME(MIN) =   4.05   TC(MIN) =  13.95

   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.350
  *USER SPECIFIED(SUBAREA):
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
  SUBAREA AREA(ACRES) =     3.70   SUBAREA RUNOFF(CFS) =     8.85
  SUMMED AREA(ACRES) =     3.90   TOTAL RUNOFF(CFS) =       9.45
  END OF SUBAREA STREETFLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOODWIDTH(FEET) = 13.62
  FLOW VELOCITY(FEET/SEC.) =  4.79   DEPTH*VELOCITY =   1.91


****************************************************************************
  FLOW PROCESS FROM NODE   302.00 TO NODE   301.00 IS CODE =   3
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.7 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =  15.7
  UPSTREAM NODE ELEVATION =    714.00
  DOWNSTREAM NODE ELEVATION =    575.00
  FLOWLENGTH(FEET) =  1370.00   MANNING'S N = 0.013
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPEFLOW THRU SUBAREA(CFS) =       9.45
  TRAVEL TIME(MIN.) =   1.46    TC(MIN.) =  15.41


****************************************************************************
  FLOW PROCESS FROM NODE   302.00 TO NODE   301.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.080
  *USER SPECIFIED(SUBAREA):
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5500
```

```
SUBAREA AREA(ACRES) =     6.90   SUBAREA RUNOFF(CFS) =    15.48
TOTAL AREA(ACRES) =    10.80   TOTAL RUNOFF(CFS) =    24.93
TC(MIN) =  15.41


****************************************************************************
FLOW PROCESS FROM NODE   301.00 TO NODE   300.00 IS CODE =  53
----------------------------------------------------------------------------
>>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
UPSTREAM NODE ELEVATION =    575.00
DOWNSTREAM NODE ELEVATION =    503.00
CHANNEL LENGTH THRU SUBAREA(FEET) =    700.00
CHANNEL SLOPE =  0.1029
CHANNEL FLOW THRU SUBAREA(CFS) =     24.93
SLOPE ADJUSTMENT CURVE USED: EFFECTIVE SLOPE =  0.1021 (PER PLATE D-6.2)
FLOW VELOCITY(FEET/SEC) =   5.22 (PER PLATE D-6.3)
TRAVEL TIME(MIN.) =   2.23   TC(MIN.) =  17.64


****************************************************************************
FLOW PROCESS FROM NODE   301.00 TO NODE   300.00 IS CODE =   8
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.738
*USER SPECIFIED(SUBAREA):
RURAL DEVELOPMENT RUNOFF COEFFICIENT = .4500
SUBAREA AREA(ACRES) =    36.80   SUBAREA RUNOFF(CFS) =    61.91
TOTAL AREA(ACRES) =    47.60   TOTAL RUNOFF(CFS) =    86.84
TC(MIN) =  17.64
============================================================================
END OF STUDY SUMMARY:
PEAK FLOW RATE(CFS) =     86.84   Tc(MIN.) =    17.64
TOTAL AREA(ACRES) =     47.60
============================================================================
END OF RATIONAL METHOD ANALYSIS
```

1